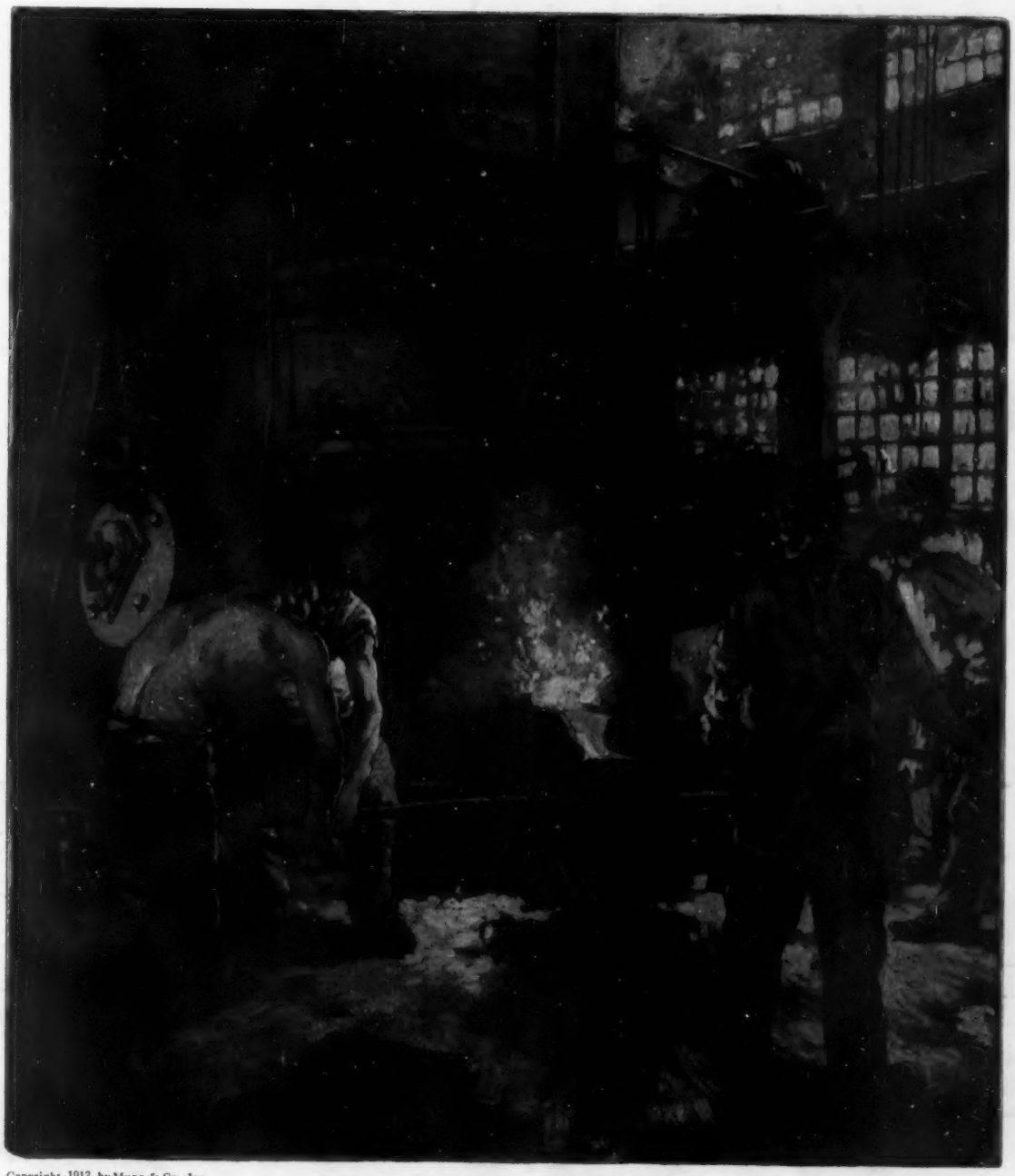
SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION



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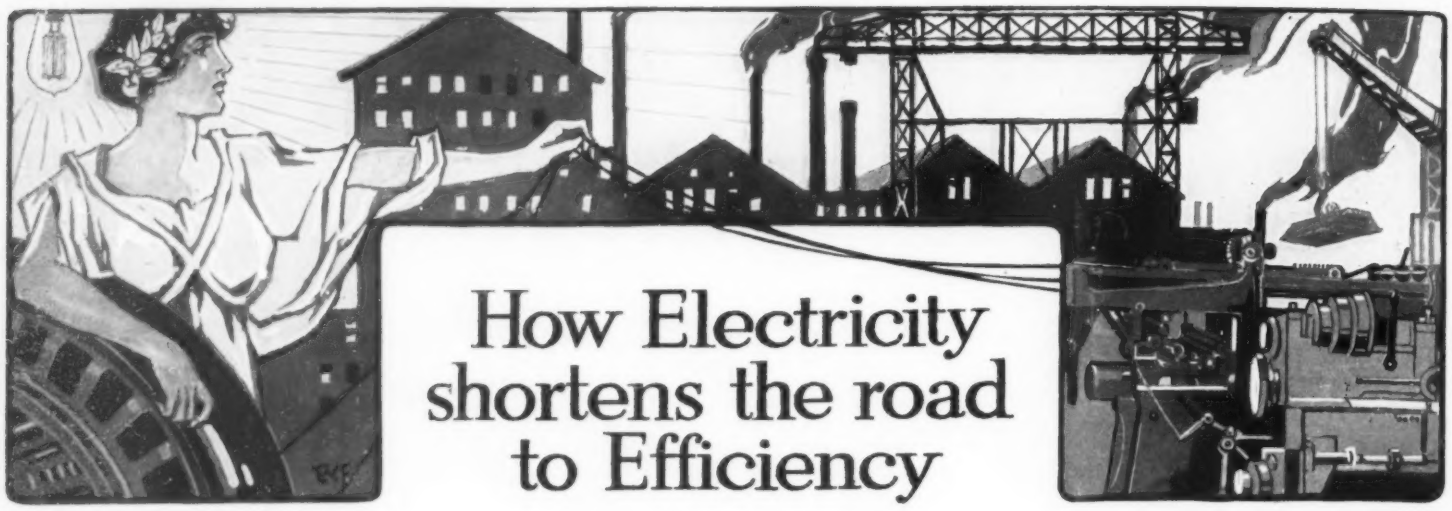

How Electricity shortens the road to Efficiency

"A road made smoother is a road made shorter," said an old engineer.

This is a pretty good text for a word about the way electricity is shortening the road to that great modern goal—Efficiency. That text applies to store and office as well as to factory, machine shop or distribution room.

The steel industry offers a practical illustration. Growth means greater needs—need for bigger tonnage output, for lower production costs, for more efficient and more economical methods with an absolute continuity of process. It was these needs that linked steel and electricity. It was electricity that played a foremost part in accomplishing that high industrial efficiency that has given the steel industry its world-fame.

Allied industries have felt the same impulse, and what has happened to construction work, mining, ship, car and engine building, is happening in countless lines of industry throughout the country. Electricity has raised efficiency in the fundamental branches of production, such as lumber, mining, cement and brick laying, textiles, paper, etc., and in the vital manufacturing lines such as clothing, food products, shoes, soap, automobiles, household goods, office equipment, etc.

In other words, the application of efficiency principles led straight to electrification. To take the textile field as another example, the leading textile mills have found it a competitive necessity and a direct economy to use electricity in subdividing power units, in answering the need for clear overhead space unobstructed by shafting and belting, and in using power sources most economically.

In paper making, the facility with which electricity could accomplish motor drive and lighting made it a natural resource for regular power as well as for supplementary lighting and emergency power generation. With wired power the mill proper need not adjoin water supply but could be located at such distance as might be demanded by shipping facilities and labor requirements. By such separation it often became possible to select the best waterfall instead of second or third best or to combine the power of several.

Not only has electricity made it easy for cereal companies to improve their output by regularity in the speed of machines, but the cleanliness of electricity, eliminating unsightly belts and dripping oil cups, has made it possible to give plants a tidiness and attractiveness that naturally led to the showplace plan for daily visitors. The visitor to the great bake shop, the towering sugar refinery or the newspaper press room sees in all these strictly modern displays of productive efficiency the results of electrical help. The visitor may not guess the advantages of the speed control, or the wide economies of operation in electrically-run machinery, but the actual cleanliness of the modern way gives an impression of efficiency that has a selling power in itself.

The reduction in insurance rates, which often follow as a matter of course, the cleanliness which does so much for the acceleration of production, the immense increase of direct productive power through both machines and men—these are great factors that have linked electricity and efficiency in the modern industrial world.

If you have a problem to be solved, take it up today with your electric power and light company, or with any General Electric Company dealer or agent in your vicinity. You will find them more than glad to co-operate with you, and no matter how complex your problem may be, they have at their command the service of any part of our organization that may be most helpful to them or to you.

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SIXTY-NINTH YEAR

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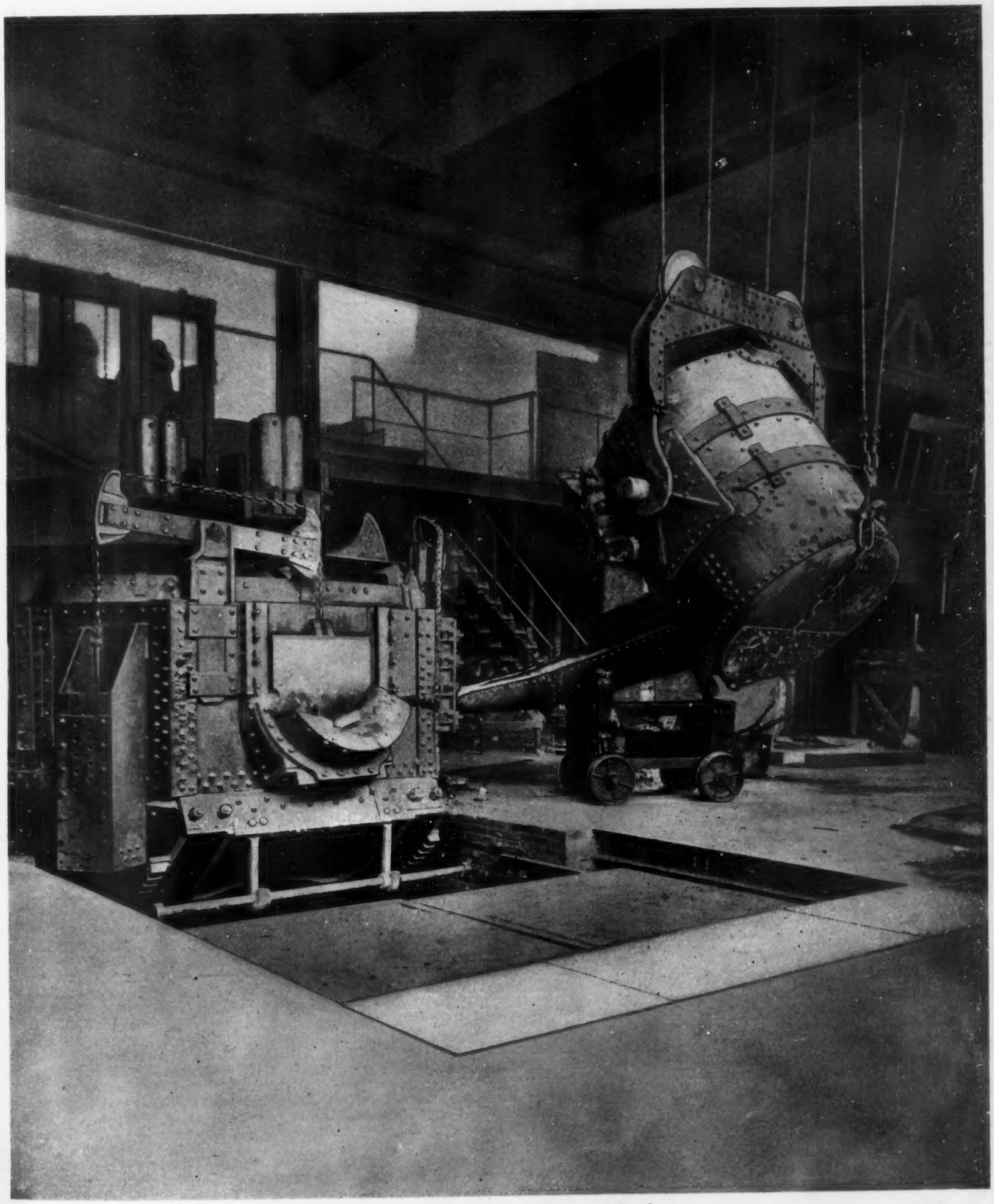

Charging the Worcester fifteen-ton electric refining furnace.

THE ELECTRIC PRODUCTION OF STEEL.—[See page 88.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Torpedo Tubes But No Torpedoes

PUBLIC attention has again been directed to the very serious insufficiency of the torpedo supply of our Navy. Congressman Britten, a member of the House Naval Committee, has recently stated that if war were begun to-morrow, we would be in a sorry plight so far as torpedo defense is concerned, some of the torpedo boat destroyers in commission carrying only sufficient torpedoes on board to fire one round from their tubes. Again, Capt. Sims of the Navy has recently stated that, although there has been expended about $50,000,000 on our present fleet of destroyers and submarines, we have not more than one torpedo for each tube; and the same authority tells us that the situation, in the event of a serious war, would be very similar to that of an army marching to battle with one cartridge in each soldier's rifle, or a fleet steaming to meet the enemy with one projectile for each of its guns.

Now in the face of this shortage—and it has been known now for several years, known in every navy of the world—it should be one of the first acts of Congress to make the appropriations necessary for doubling the capacity of the naval torpedo factory at Newport, and for the immediate purchase of torpedoes in sufficient numbers to bring our supply on hand up to the required standard. At present, we have about 1,000 torpedoes on hand, whereas the principal foreign navies, according to Capt. Sims, have from 6,000 to 10,000. Surely every member of Congress, be he big-navy or little-navy, battleship or no-battleship, in his attitude, will realize that the first thing to do and the least that can be done, is to make an early appropriation to bring such battleships, torpedo boats and submarines, as we already possess, up to their full fighting efficiency.

Another Call for the Fireproof Stairway

A LIGHTED cigarette, an abundance of combustible fabric, and a fire-trap stairway, appear to have been the contributory causes of another factory fire-horror—this time at Binghamton, New York. With the appeals of the victims of the Triangle fire in this city still in the public ears, there come the cries of over half a hundred girl victims of another fire, calling for stern legislative action to render a further repetition of such a ghastly disaster impossible.

When the fire broke out, there was a certain amount of panic of course; there always will be in a factory of this character. In the construction of such buildings this fact should always be kept in view. The means of egress should be ample, and those for descent to the street, whether by elevator or stairway, or both, should be such that when the inmates of any floor have made their escape from the main building, they will be sure of gaining the ground in safety.

Now the only sure way to secure these conditions, as we pointed out after the Triangle fire, and many times in years preceding that disaster, would be to construct both elevators and stairways, or at least the stairways, in a separate fireproof shaft or well, built exterior to the main wall and having no direct openings from itself to the various floors. The complete exclusion of flame and smoke from the stairway would be secured by placing the doors leading to the stairway at the various floors, outside the stairway shaft, with concrete or iron platforms leading from the main building to these doorways. A fireproof, inclosed stairway of this character, built external to the main walls of the factory, would have reduced the terrible list of fatalities at Binghamton and possibly would have enabled every inmate to escape.

The majority of the so-called fireproof stairways in existing buildings are such only in name. To build a stairway of incombustible material is not sufficient to render it fireproof in the sense that it will present a safe means of exit from the building. A stairway is fireproof in this sense only if the construction is such as to exclude the suffocating gases, which are the most fruitful cause of death in conflagrations. It should be better understood than it is that of the people killed in fires, the great majority die, not by actual contact with the flames, but through suffocation by inhaling the products of combustion. A notable case of this was the fire about ten years ago in the Park Avenue Hotel, this city, in which the majority of the victims were not even scorched by the fire. Now when the doors leading to the so-called fireproof stairways open directly from each floor onto that stairway, the latter is liable to serve merely as a big vertical flue, which, when the doors are opened, is liable to draw the smoke and gases into itself, and render the stairway impassable, except at risk of quick suffocation. In some of the latest buildings such stairway wells, entered from the outside of the building, are built within the building lines. The better and safer construction is to form the well outside of the building; this for the reason that the entrances at the different levels are farther removed from the rising columns of smoke and gases.

Vitalism and Mechanism

THE camp of biologists is divided. There are those who hold that the phenomena of life involve a separate principle which does not operate in non-living matter. Another school seeks to interpret all actions or functions of the living organisms in terms of the general laws of nature which are known to apply to all matter living or dead.

To us it appears premature to take any side in this dispute. There is a very wise principle current among scientific men, that the aid of a new hypothesis shall not be invoked, so long as a given set of phenomena can be explained without it. It is therefore clearly the best policy in the investigation of life phenomena, to press forward as far as we can by the application of the methods and principles with which we are familiar in the physical world in general, and to see just how much of the remarkable phenomena presented by living matter we can explain in terms of such general laws, before we attack the question whether, after all has been done in the way indicated, there still remains a certain residuum of facts which cannot be accounted for in this way, and for the explanation of which we must postulate some special "vital principle" or whatever we may like to call it. This course is obviously free from any possible objection. It denies nothing. It makes no assertions as to what can or cannot be done. It proposes simply to continue work along lines which have proved most fruitful in other directions and which have begun to bear very valuable fruit in the special field of biology also.

The work of Prof. Leduc may to some appear to have little bearing upon life phenomena. His adversaries may see in his experiments a mere accidental resemblance to certain appearances observed in the living world. While this criticism may possibly not be altogether unfounded as regards some of his experiments, in the case of others the burden of proof lies heavily upon the critics. And in any case, the work of Leduc will have furnished interesting and important data on physical questions, even if we utterly disregard its possible or probable bearing upon life phenomena.

Upon another page we bring in this issue a review of Prof. Leduc's work "Synthetic Biology," and some additional data of his researches will be found in this week's issue of the SCIENTIFIC AMERICAN SUPPLEMENT. The French savant's investigations relate more particularly to effects observed in the purely physical world, resembling and, in Leduc's opinion, identical with the phenomenon which biologists have termed chemotaxis. This term is employed to designate the property possessed by certain organisms of being attracted or repelled by certain chemical substances introduced into the water in which such organisms are floating freely.

To the naïve observer these organisms appear to be guided by some sort of intelligence to seek out certain materials and to shun others. To ascribe intelligence to lowly organisms of this character is in itself a very doubtful proceeding. It becomes still more doubtful when it is shown, as brought out most clearly in Prof. Leduc's work, that precisely the same kind of behavior is displayed by purely inorganic substances. Particularly instructive is an experiment described by the French biologist, in which a rod which has been dipped in alcohol is brought to within a fraction of an inch from the surface of water containing a drop of India ink. The vapor of the alcohol comes in contact with the water and causes the India ink to turn away from the point affected. To express matters graphically, it might be said that the India ink "smells" the alcohol, and Leduc suggests that our sense of smell may be based on just this kind of action.

The line of experiment followed by Prof. Leduc is one which bears great promise of important further disclosures. We have here a young branch of science, and it is the young branches which grow most actively.

An Epochal Achievement in the Electrical Arts

ONE of the latest, and certainly one of the most important applications of electricity to the industrial arts, is the use of the electric current for the refining of steel in large commercial quantities such as are called for by the heavy trades. This is an improvement whose far-reaching importance has hitherto been appreciated only by those who are interested in the theory and practice of steel manufacture.

The introduction of the Bessemer converter made it possible to manufacture steel in large quantities at a low cost, and laid the foundation of the present enormous development of the steel industry; and from the time when the Bessemer converter was made a practical success down to the present day, the principal efforts of the steel makers have been directed to removing certain impurities and defects which are inseparable from the Bessemer process. The Siemens-Martin open-hearth furnace was the first successful competitor on a large scale with the Bessemer converter, and the open-hearth treatment has rendered it possible to turn out steel in equal quantities, of a superior purity, and for a slightly greater cost than by the older method.

There has always been a market for a special steel, possessing in the highest degree the purity, homogeneous structure, and relative hardness and toughness, which are necessary when steel is to be subjected to the most severe uses, and for many decades a limited amount of such steel has been made by what is known as the crucible process. But this process has always been and is to-day a costly one, and its product is so expensive and its output so limited, as to render its wholesale use for the production of cheap steel such as used for rails, bridge work and in the heavier steel trades, quite out of the question.

In searching for some new method that would combine the capacity of the converter and the open-hearth furnace with the purity of the product of the crucible, it was inevitable that the thoughts of the steel maker should turn to the electric current; and over thirty years ago Siemens made some practical experiments on a small scale, by which he succeeded in making limited quantities of steel by the use of the electric arc. The very interesting development of his invention, as sketched out elsewhere in this issue, shows that the success of this method on a commercial scale was merely a question of the progress of electric engineering. This development has been so rapid, and the results already achieved are so full of promise, that the introduction of the electrical refining of steel can be said to mark an epoch in the history of the art, measurable in importance to the advent of the Bessemer converter and the open-hearth furnace. During a single decade the electric refining furnace has increased in capacity from two or three tons to thirty tons, and the present annual output has reached in round numbers about 1,300,000 tons.

The significance of these figures can scarcely be overestimated. They mean that the day is within sight when, at a cost not very much greater than the present cost of Bessemer and open-hearth rails, steel rails, for instance, will be supplied which will possess the wearing qualities and the toughness to enable them to stand up under the heavy wheel loads of American traffic, even during the low temperatures of the winter season.

For the present, electrically refined steel, though far cheaper than crucible steel, will of course be considerably dearer than Bessemer and open-hearth. The promise of the future as regards the lowering of the cost of the new steel lies in the fact that in the operation of the Heroult furnace, which bids fair to gain exclusive control of the field, there is this important economic fact, that the larger the furnace the less is the cost of refining. Furthermore, there is nothing in the construction or principles of operation of this furnace to prevent its being built in sizes equal to the large open-hearth furnaces of 100-ton capacity now in use. There are electrical-steel furnaces of 15-ton capacity working successfully in this country, and others of 25 tons are planned. In Germany 30-ton furnaces are being built, and altogether the indications are that within a few years' time, thanks to this latest application of the electric current, steel of the very highest quality will be available at moderate cost, and in any desired quantity.

Engineering

A New High Explosive.—A new high explosive, trotal, possessing in a high degree the desirable qualities of a shell-burster, has been developed and demonstrated. It is the invention of Lieut. Harold C. Woodward of the 22nd Engineers, National Guard, New York. The explosive, which can be detonated only by fulminate of mercury, has been fired in a 12-inch shell against armor plate without exploding. It is claimed that 6 ounces of trotal will do the work of 12 ounces of dynamite.

Trying to Burn a Steel Car.—In testing out the steel car with a view to proving its indestructibility by fire, The Pennsylvania Company placed in one of this type 200 pounds of shavings and wood saturated with oil, set fire to it and allowed the mass to burn itself out. The paint and upholstery were destroyed, but no damage was done to the car as a structural whole. At present, 2,872 steel passenger cars are in service on the Pennsylvania system, and this is about one half of the total of steel passenger cars in service in the United States.

Storm Warnings to Shipping.—Recently the Navy and Agricultural departments inaugurated a wireless service, by which storm warnings and weather forecasts for ships at sea will be sent out, the service covering conditions one hundred miles offshore throughout the full length of the Atlantic coast. The messages will be sent from the naval wireless stations at Radio, Va., and Key West, Fla. They will reach ships distant several hundred miles at sea, giving them the forecast of the weather for forty-eight hours, with special warning of severe storms.

Locomotive Size Limited by the Fireman.—We are informed by the Baldwin Locomotive Company that today the factor determining the size and power of large locomotives is the physical endurance of the fireman, and that an ordinary fireman cannot put in the firebox more than five to six thousand pounds of coal an hour. This is one of the considerations which render compounding and superheating, which together, under favorable conditions, secure as much as 40 per cent economy in the fuel burned for a given output, such valuable factors in the development of the locomotive.

New Navy Yard Proposed at New York.—The House Naval Committee investigated, last week, the proposal of Capt. Louis S. Van Duser, made when he was captain of the New York navy yard, to abandon the present navy yard at Brooklyn, and build a new yard at Communipaw on the New Jersey shore of New York harbor. He claims that the present yard is insufficient in area and accommodation, and he would substitute at Communipaw an entirely new yard of 400 acres, with pier accommodations sufficient to berth 40 battleships, 20 torpedo craft, and 100 tugs, barges and submarines.

Cost Versus Cleanliness.—In the litigation over the question of polluting New York harbor with New Jersey sewage, New Jersey has at last come to the conviction that the cleanliness involved in the plans for sewage treatment is well worth the proposed expenditure of money. Under the plan proposed, the sewage after treatment can be discharged into the New Jersey tidal waters without injury or offense either to New Jersey or New York. The question is one of public health and, as such, it is one of the most important of the many similar questions which are now before municipalities in various parts of the United States.

To Beautify the Panama Canal.—There is happily a growing tendency to seek the collaboration of the architect and the artist in giving such beauty to engineering works as the conditions will allow. This is particularly true in regard to the dams and reservoirs of waterways and works for water supply, and excellent results have been obtained in the treatment of certain of the great dams, such, for instance, as that for the supply of New York at Croton and of Boston at Wachusett. In this connection we are pleased to learn that the Fine Arts Commission has submitted to Congress plans for the beautification of the Panama Canal, in which are embodied landscape effects designed to render artistic the locks and the approaches to the canal.

The British Naval Maneuvers.—The thoroughness with which the British give all branches of the navy a thorough training in practical sea service, is shown by the fact that 346 ships of all classes were engaged in the summer maneuvers of the present year. The fleet included sixteen dreadnoughts, five dreadnought cruisers, twenty-five other battleships, twenty-seven other armored cruisers, thirty-five small cruisers, one hundred and sixty destroyers, forty-two submarines, eleven destroyer depot ships, eight submarine depot ships, seven mine layers, six mine sweepers, two repair ships, one hospital ship and one aerial depot ship. The last-named vessel, the cruiser "Hermes," was fitted to carry three hydro-aeroplanes. The total tonnage of the fleet was 1,604,889 tons.

Electricity

The Condenser Telephone.—The inventors Ort and Rieger are quite successful in their work on the condenser telephone, having taken up the question in Germany with the idea of improving the results obtained by this method, and were able to produce excellent telephone receivers, it is said. They first made use of a condenser made up of sheets of tissue paper treated with shellac and covered with tinfoil so as to form a 0.05 microfarad condenser, and when used on the receiving end of a telephone line they found that it vibrated quite like a receiver and delivered articulate speech under better conditions than heretofore. A still better makeup was of thin membranes of rubber stretched drumwise and covered with very thin films of aluminium as fine as 0.00012 inch, the thickness of the rubber being about the same. Even greater success was now obtained, and the inventors state that the condenser vibrates as well as the common telephone receiver and even better, and gives clearer speech than has hitherto been obtained.

"Silite."—A composition which the German inventor Dr. Egly calls "silite" is said to be an excellent material for making up electric heating resistance pieces and the like. It is a compound of silicon and silicon carbide, and answers to all the requirements, for it is not injured by the heat and at the same time conducts the current, being also compact and substantial, and can be molded in any shape. "Silite" is not attacked by acids nor affected by expansion and contraction under heat. The inventor tried carborundum and silundum without success, then he found the present method, which consists in mixing silicon carbide with silicon and a suitable binding material, heating the mixture and then giving it a final treatment in the electric furnace. In this way he obtains any desired molded shapes in a homogeneous and non-porous substance. As it is a conductor of current, it can be used to make up electric heaters of various shapes. Another use is for rheostats and controllers, and the inventor finds that tubes up to three inches inside diameter will come to a high heat when under current, so that they serve for wire-treating furnaces or for tempering steel springs, such tubes being very durable.

Portable Wireless of Tuning-fork Type.—The Paris engineer H. Magunna, whose work with the late Prof. Mercadier in vibratory multiplex telegraphy is well known, now brings out a system of portable wireless outfits for military use in which he employs a new musical spark method. This consists in the use of tuning forks which break the 220-volt current at a constant rate of 750 vibrations, and a rather original method is used to keep up the vibration of the forks; for instead of using electro-magnets, which have some drawbacks for this use, he employs a very small electric motor to drive an endless belt stretched between two pulleys so as to run continuously, and the sharp angle of one prong of the fork is presented to the belt surface so as to keep the fork in vibration by this purely mechanical means. The fork, the transformer primary and the telegraph key are mounted on the circuit of a small dynamo, using a condenser to suppress the spark, and the frequency of the current thus obtained is quite constant at the same rate as the fork and is independent of the dynamo speed. He makes up very light portable wireless plants on the musical system, for aeroplanes and airships, army field use, fishing boats and the like. One box contains the 1¼ horse-power gasoline motor and small dynamo, and another the tuning fork apparatus.

Hydraulic Power Plants in Calabria.—Southern Italy is to secure a large amount of hydraulic power in the Calabria region for operating electric plants, and it is expected to lay out water storage reservoirs so as to obtain 50,000 horse-power. The Sila mountain region has an abundant rainfall, but this is quite irregular during the year, for some streams which are torrents in winter are nearly dry in the summer season. In order to regularize the flow there will be used four great reservoirs, the largest of which will contain 5,000 million cubic feet of water. At the start, there will be erected a 50,000 horse-power turbine electric plant, and part of the current is to serve the nitrate of calcium fertilizer works, the remainder to be sent over long power lines through Calabria and neighboring regions. Agriculture as well as hygiene will profit by the new enterprise, as there will now be no marshy or desert land and the country will have a rational irrigation system, owing to the regular water supply. Sardinia is to have a somewhat similar scheme before long, and as this island is especially devoted to horse and stock raising, it is expected that the quality of fodder will no longer suffer during dry spells. The river Tirso is to supply a reservoir of 10,000 million cubic feet for use with a 15,000 horse-power hydraulic plant, and the water will irrigate the Cagliari plain. Numerous mines will use the current for power instead of expensive coal.

Aeronautics

The Wilbur Wright Fund.—Horace Darwin, former Mayor of Cambridge, England, and a member of the Advisory Committee for Aeronautics, delivered a lecture on May 21st in aid of the fund to build a memorial to Wilbur Wright.

The "Record" Altitude for Captive Balloons was attained at the Lindenberg Observatory on February 20th, 1913, when three of these balloons were sent up to a height of 7,180 meters above sea-level (23,556 feet, or about 4½ miles). This is a little less than the "record" altitude for a kite (23,826 feet, at Mt. Weather, Va., May 5th, 1910).

A French Aeronautic School.—The school of aeronautics and mechanical construction which was founded at Paris a few years ago is now in very successful operation and is well attended. It is of an industrial character, and is intended to turn out engineers for the mechanical industries in general, and more especially for the branches of aeronautics, automobile and allied industries. Entry to the school is determined by competitive examination, and to prepare for this there is instituted a preparatory course in a separate school.

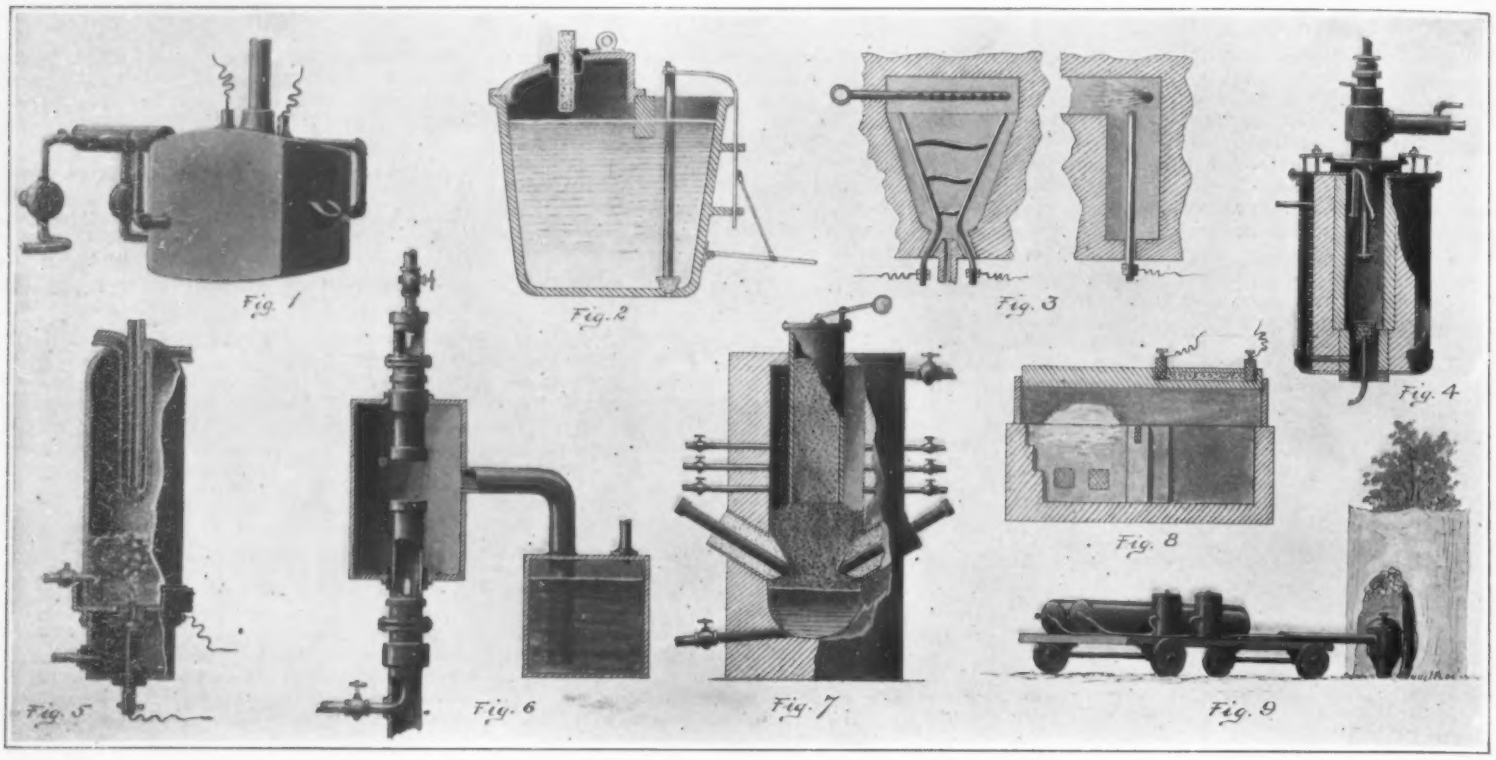
Natural Gas for Balloons.—We are informed by Prof. F. DeR. Furman of Stevens Institute that one of the graduates of Stevens recently made a little pleasure trip in a balloon inflated with natural gas. The ascent took place at Akron, Ohio, and was the first ascent in a regular touring balloon ever made from that town. So successful was the trip that there is a chance of forming a small aero club in Akron to make regular ascensions at a cost probably not exceeding $10 per passenger. The pilot of the balloon was R. H. Upson.

Making the Aeronautic Engine Non-gyroscopic.—William Phillip Holzmark of St. Louis, Mo., assignor of one half to Isaac Holzmark of same place, in patent No. 1,060,597, describes a non-gyroscopic engine in which two reversely running engines have a series of axially alined crank shaft sections with a reversing gear which permits one of said sections to rotate in one direction while the adjoining section rotates in a reverse direction and a single propeller is connected to one of the sections in such manner as to be driven simultaneously by both of the reversely running engines.

Dr. Bell and Transatlantic Flight.—Dr. Alexander Graham Bell recently announced that F. C. Baldwin, one of his assistants, seriously thinks of crossing the Atlantic in an aeroplane, in an effort to win the British $50,000 prize. According to the newspapers, Dr. Bell proposes that the flight be made at an altitude of five miles, where one third the density of normal atmosphere would permit a great speed. However the altitude record held by Legagneux, is only 17,878 feet, which means that Baldwin will have to go about 8,500 feet higher. There is trouble enough with motors, not to mention the human breathing apparatus at a height of three miles.

A Parseval Dirigible for the British Navy.—A Parseval airship constructed in Germany for the British navy has been accepted by the Admiralty Air Department. The vessel is the nineteenth constructed by the Parseval Company. The present airship is designated as "P. L. 18," the first of the series which came out in 1906 being regarded purely as an experiment. The new British Parseval has two Maybach engines of 180 horse-power each, which drive two four-bladed propellers. The envelope has a capacity of 310,740 cubic feet; consequently the craft is nearly 130,000 cubic feet larger than the existing army airship "Delta." The length of the vessel is 275 feet and its greatest diameter forty-nine feet. The fabric is treated with aluminium. At its first trial the airship is said to have developed a speed of 42.4 miles an hour. The lifting capacity is nearly three tons, exclusive of its own weight.

The Dynamic Meter is, according to international agreement, the unit hereafter to be employed in aerological tables and discussions in expressing altitude. The need of replacing geometrical by dynamic altitudes in dynamic meteorology depends upon the fact that the force of gravity is not the same in different latitudes. In studying atmospheric movements it is desirable that the system of coordinates adopted should include planes at every point of which the force of gravity is equal, so that the work required to transport a mass of air from one plane to another against gravity is always the same. The dynamic meter is defined as a vertical distance corresponding to 100,000 C. G. S. units of gravity potential and is equivalent, on an average, to 1.02 ordinary meters. The name of this unit, which is one of several new terms proposed by Prof. Bjerknes, has aroused much criticism.



Recent applications of the electric furnace in the industrial arts.

Some Recent Improvements in the Use of the Electric Furnace

Novel Uses for the Electric Current in Industry

EVER since the classic experiments of Davy in 1801 of drawing an arc between two pieces of charcoal, and showing the enormous heat that can be produced by the electric current, the use of electricity for the production of high temperatures has been a very powerful weapon in the hands of the scientist. But the means then known for generating current were of the crudest type, and it was not until the Siemens dynamo was placed upon the market that there was any possibility of the commercial use of the electric furnace. Current generated by means of steam engines as prime movers was still too expensive and was unobtainable in large enough quantities to warrant extensive use. The greatest impetus was received by the installation of large water power stations such as the Niagara Falls plant, where current is obtainable at greatly reduced cost, and in almost any quantity. Under these favorable conditions the electric furnace has become a most useful and important factor in a great number of industries. This in turn has furnished favorable opportunities for inventors, and the last year has seen a considerable number of improvements in electric furnace processes, as well as in the structure of the various types of furnaces.

One great field of work has been in the iron and steel industry. This subject is treated historically in a separate article in this issue; but we present herewith illustrations of two of the latest patents taken out in the United States. The first of these is the scheme invented by Albert E. Greene of Chicago, Fig. 1 (patent Nos. 1,034,787, 1,034,786, and 1,034,785), which consists in maintaining the roughly blown steel as it first comes from the converter at a constant, predetermined temperature, and blowing through it a mixture of gases that have the effect of oxidizing out some of the impurities that it is desired to eliminate. At the same time the molten mass is subject to the action of a slag that floats on top, which will dissolve out the other impurities.

A different process for obtaining purified iron of a very uniform quality is due to William R. Walker of New York, Fig. 2 (1,035,280). By this method the "microscopic slag" is more thoroughly removed and a better mixing of the constituents of the molten mass is obtained. The rough iron is blown in a converter which has a "basic" lining, and then is poured into a mixer, the lining of which is of a non-acid nature. From there it is poured into an electric furnace, the lining of which is of "acid" nature. Here it is given the final purification and poured into a large mixing ladle and from the mixing ladle it is transferred to the pouring or casting ladles. This is a continuous process and the products from several units are continually exchanged, the result being a very uniform product. The basic lining of the converter takes out the phosphorus, and the slag on top of the mass takes up the sulphur. The large mixing ladle gives the finely divided slag a chance to separate out, as the iron is still in a highly heated condition, which allows a longer and more thorough purification. The advantage of using the acid lining in the electric furnace is that the lining lasts longer and is more easy to replace.

Besides the steel industry the synthetic production of nitrogen compounds, commonly known as "fixation" of nitrogen, is another industry furnishing a great prospect for the inventor. These nitrogen compounds are used in making nitric acid, and further in making all kinds of fertilized compounds for agricultural purposes. The idea of combining the free nitrogen and oxygen of the atmosphere has long been proposed, but the practical difficulties are unusually great. Previously the chief difficulty appeared to be in obtaining a high enough temperature. The electric furnace has supplied this requisite; but another and a more serious difficulty appears in the fact that the compounds at the temperature of formation are quite unstable and tend to break up just as fast as they are formed. If these gases can be cooled immediately upon leaving the zone of formation, they may be preserved in a fairly stable state until they can be further combined. It is a difficult matter to cool the gases without at the same time cooling off the furnace, and thus wasting a great deal of energy. The gases must be caused to come uniformly in contact with the hottest part of the furnace, to obtain a uniform product. A number of inventors have attacked this problem with the view of putting out the arc and then striking it again, the interval being used to cool off the gases. Heretofore this has proved to be an inefficient way of dealing with the problem.

Recently two French engineers, Bunet and Baden, Fig. 3 (patent No. 1,035,684), have devised a way of causing intermittent arcs, which is claimed to increase the efficiency of the apparatus to a marked degree. As electrodes they use two conductors arranged like the terminals of the well known "ram's horn" circuit breakers for high voltage circuits. These electrodes may be merely two rods, or the one may take the form of a funnel with the other projecting up through the center as a plain rod or plurality of rods. Air is blown up through the shortest part of the gap between the electrodes by means of a jet of rather high velocity. This of course tends to blow the arc up with it until the gap is so great that the arc can no longer leap the gap, and as a consequence it breaks. But the voltage of the circuit is great enough to cause another arc to form at the lower end of the gap, where the distance is least. In fact, the inventors claim that in operation, several arcs simultaneously travel up toward the top of the electrodes. From the top of the electrodes the combined gases are led directly into a spray of water or steam. The principle of the magnetic blowout has also been used by the same inventors, to cause a rapid succession of arcs.

Another apparatus for producing compounds of nitrogen, devised by H. D. Rankin of Joliet, Ill., Fig. 4 (patent No. 1,056,830), shows a hermetically sealed furnace in which an arc is maintained while air at a pressure of from three to ten atmospheres is forced into the chamber. At the top of this chamber is a water-cooled electrode and around it is the discharge pipe of the furnace. This discharge pipe is also water-cooled and serves to cool the combined gases just as soon as they rise from the arc. The electrodes are made of metal or of carbon charged with metallic oxids to give what is known as a flaming arc, which is easier to maintain. The pressure of the gases makes the arc more difficult to maintain, due both to the increased insulating properties of the compressed gases and to the flow of the gases. After the gases are cooled they are led into absorption towers, where the oxids of nitrogen combine with water and the oxygen of the air to form nitric acid, according to the commonly accepted equation $2H_2O + 4NO_2 + O_2 = 4HNO_3$.

Another noteworthy method of fixation of nitrogen is the invention of Joseph R. L. Hayden, Fig. 5 (patent No. 1,046,421). An electric arc is formed inside of a closed air-tight chamber into which compressed air is forced. The upper electrode is a hollow rod and the arc is formed between the lower electrode and the rim of this hollow rod. The only means for the gases inside of this chamber to escape is by passing through this hollow arc and out through the hollow electrode. But this electrode has its top connecting directly with the bottom of a vessel which is partly filled with water. This water is kept from escaping as steam by means of circulating cooling pipes. The gases are taken from this chamber and are run through absorption towers where nitric acid is formed. This process has the advantage of cooling the gases immediately after they are formed. The fact that the gases must all pass through the heated zone of the arc insures a thorough action.

But not only in these two great industries do we find the electric furnace useful, for a great number of minor industries owe their existence to the electric furnace. For instance, the manufacture of gas for lighting, heating, and industrial purposes is accomplished by the dissociation of steam in the presence of carbon dioxide or a hydrocarbon. The resultant gas composed partly of free hydrogen and in part of carbon monoxide is useful wherever natural or coal gas can be used. M. W. Murray, Fig. 6 (patent No. 1,056,045),

shows the apparatus necessary to practise such a process. Two tubular electrodes lead into an air-tight chamber the collecting tube of which is provided with a water seal. By means of nozzles, steam and carbon dioxide or a hydrocarbon are discharged into these tubular electrodes. It seems that the metal vapor of the electrodes acts as a catalytic agent. One great advantage lies in the fact that the composition of the gas can very easily be determined by adding the proper constituents.

The fertilizer industry with its tremendous possibilities looks largely to the electric furnace. The natural rocks that bear phosphorus are difficult to break up and the tremendous heat of the electric furnace is one of the most powerful means of breaking up these stable compounds. Such a process is practised in the furnace as shown by F. S. Washburn, Fig. 7 (patent No. 1,044,957). Carbonaceous material such as coke or coal screenings is charged in with the rock and the charge is heated by the passage of the current therethrough. Air in restricted amounts is admitted and the phosphorus is displaced from the rock by the carbon and passes off mostly as the pentoxid of phosphorus. The process is continuous, as the furnace is of the magazine type. The inventor claims that by the use of his apparatus he can obtain as much as 90 per cent of the combined phosphorus. The product thus obtained can be utilized in a great variety of ways, such as in the production of fertilizer and matches.

Another industry that has been aided by the introduction of the electric furnace is the glass industry. The ease of controlling the exact temperature is a great factor in the success of the furnace. In a process carried out by Marius Sauvageon of Paris, Fig. 8 (patent No. 1,062,362), the glass itself forms the resistance material. The furnace is started by pouring in some melted glass which, as is well known, is slightly conductive when in the molten condition. The current passing through the molten mass furnishes the necessary heat to melt the charge of sand and soda that is used as the raw material. The melted glass flows out from under a barrier which serves to restrain the raw material from becoming mixed with the finished glass. Such a furnace is very pleasant for the workmen to handle, as the heat is localized at the central point of the furnace just where it is needed, and the glass is withdrawn from the outer or cooler part. There is no danger of the workmen getting a shock, as the voltage is low.

A very peculiar and ingenious use to which the electric furnace has been put is described by Howard R. Connel (patent No. 1,023,229), whereby jewels for meters and cheap timepieces are made and finished in almost complete form at one operation. A carbon block with some hemispherical depressions is arranged to form the holder of some powdered tungsten. Upon heating the block in an electric furnace the tungsten is fused and forms upon its outer part a carbide of tungsten, which is an extremely hard substance. In each depression is formed a small boat-shaped bead just right for a jewel.

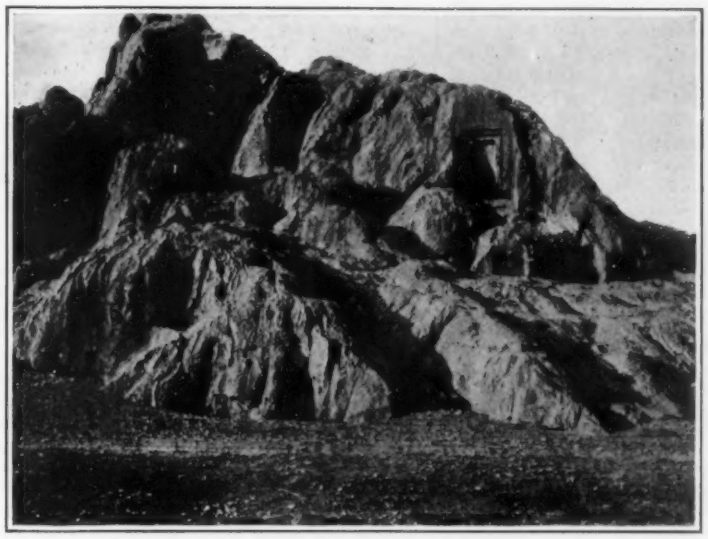
Another rather odd use to which the electric spark has been put is in a process for fumigation and killing of insects, Fig. 9 (patent No. 1,037,744). Two tanks of gas, one of nitrogen and the other of acetylene, are arranged to discharge their contents in the proper amounts into a chamber which is traversed by a spark. Under the action of the spark the gases unite to form hydrocyanic gas, which is very highly poisonous. When used to fumigate trees it is usual to inclose the tree in a tent and put the apparatus within the inclosed space. The control is effected by a switch some distance away.

Cutting Hair by Machine.—In patent No. 1,064,053, A. R. Coyle, Jr., of Trafford, Penn., shows a hair-cutting apparatus which is provided with cutting blades operated by means of a vacuum and the vacuum also serves to draw the hair to be cut into the path of the blades or cutters and delivers the cut hair to a suitable receptacle.

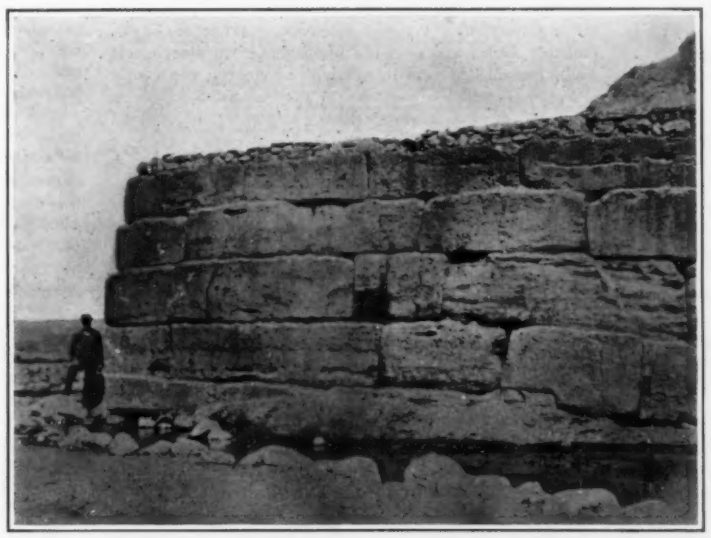
A Statue from the Land of Semiramis

By Edgar J. Banks

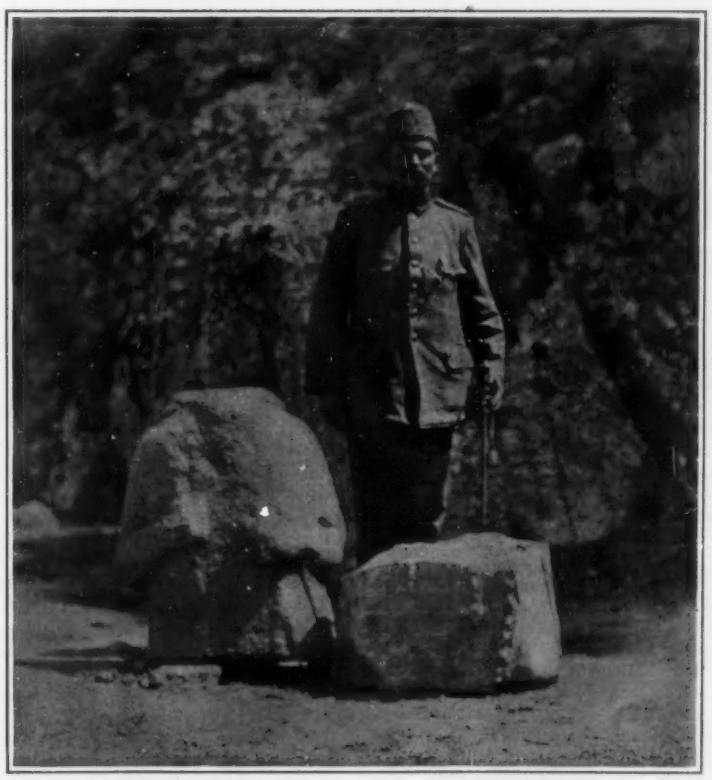
SEMIRAMIS, the Oriental queen, who, until recently, was supposed to have lived only in myth, has at last become a character in real history. Legend says that she was the daughter of a fish goddess, that she was miraculously fed by doves and reared by a shepherd, that she was married to a governor of Nineveh, and won from him by King Ninus, that the king resigned to her his crown, that she built Babylon, and ruled Assyria for nearly half a century, that she was transformed into a dove, and was worshiped as a goddess. Recently, however, the German excavating expedition to the old Assyrian capital city Assur has discovered that one of the legends was true; she was really the wife of a king of Assyria.



The shepherd's rock and inscription from the age of Semiramis.



The Van castle wall, built in the time of Semiramis.



Remains of a statue from the age of Semiramis.

Near one edge of the ruins of Assur the Germans discovered a hundred or more tall stone monuments, monoliths from four to eight feet high, standing side by side like gravestones in a cemetery. Most of them were inscribed near the top with a few lines of ancient Assyrian cuneiform writing. They were monuments erected in honor of the kings and nobles of Assyria, and one of them bore the inscription of Semiramis, which, with one exception, is the only mention of a woman of high rank upon the monuments of Assyria. The inscription reads: "The column of Sammuramat, the wife of the palace of Samsi-adad, king of the world, king of Assyria, the mother of Adad-nirari, king of the world, king of Assyria, . . . ? of Shalmanusharid, king of the four regions."

Sammuramat and Semiramis were one. Instead of twenty-two centuries B. C., she lived about 750 B. C., and the fact that a monument was erected to her may indicate that she was really a queen, and one of the greatest of rulers.

Her name to-day is still a common word in the more remote portions of the Turkish Empire, throughout all the region from Van, the old Armenian capital, to the ruins of Nineveh. Shamiram, as she is now called, must at one time have been the ruler of all that country, for it is also filled with monuments associated with her name. Local tradition says that she was the queen of Van before she became the wife of the king of Assyria. It is the Shamiram aqueduct which still brings the water to the Armenian city. Upon the summit of a high hill near Van are the ruins of a rock-hewn fortress and of a temple attributed to her. Scores of cuneiform inscriptions in the vicinity come from her time. In the very center of the city is a high rock surrounded by massive stone walls. Cut into its sides are long inscriptions and rock-hewn fortresses and a palace in which she is said to have lived. Upon the summit are the ruins of a fortification. Recently, the Turkish soldiers, who are stationed on the summit of the rock, discovered among the ruins the greater part of a large black stone statue. Too heavy for them to carry away, or ignorant of its value, they left it there among the rubbish, where I found it. It is headless; the body is broken into two parts; its feet, or the pedestal into which they were imbedded, have disappeared; the arms, bent at the elbows, are built into the body; in the hands are two implements, probably the symbols of office; the dress is a long tunic open in front with fringe along its edges. Though the head is missing, the hair was long; traces of it still appear on the shoulders.

The date of the statue is certainly the same as of the ruins in which it was found, and of the inscriptions upon the rocks, or about 750 B. C. It comes from the time and people of Semiramis, and though probably not of that queen, it is the only known Vannic statue, and as such, is of unusual historical interest. Research in this almost unknown land of Semiramis promises to restore the lost history, art and literature of the empire of this once supposed mythical queen.

Fire Waste at the Conservation Congress

FIRE waste in the cities of the United States as allied to forest and water conservation will be given a prominent place in the deliberations of the Fifth National Conservation Congress to be held in Washington in November. Facts and figures emphasizing the tremendous loss caused by unnecessary fires will be laid before the congress by speakers of national note and means will be considered for the reduction of this vast waste.

Fighting in the Air

By Carl Dienstbach

THE German press was recently permitted to publish the results of tests in which many hundred rounds of ammunition were fired from a machine gun mounted on top of a Zeppelin airship in flight. As could be foreseen from the absolutely stable nature of that gun platform and from the entire lack of vibration and swaying, these tests were almost as successful as they would have been had the gun been discharged at the top of a mountain. The writer speaks from experience, having made tests in aiming from the window of the cabin of the "Victoria Luise" in full flight.

These machine gun trials were conducted to test an airship's ability to defend itself against aeroplanes. The prowess and the number of French aeroplanes made some such demonstration imperative during the political stress of the Balkan situation. The French seem to have attached little importance to the armament of the Zeppelins in view of the ever-increasing climbing powers of aeroplanes.

Aeroplanes have recently reached altitudes, even with passengers, that are still prohibitive to airships, except at the sacrifice of much gas and carrying capacity. A dirigible's faster climbing is offset, it is argued, by the aeroplane's ability to operate against the airship at a high level from the outset. Nothing prevents an aeroplane from doing much of its climbing at the start. Such was the lesson taught by the aviators who crossed the Pyrenees and the Alps.

In France aerial fighting is considered a mere climbing contest, a duel between two artificial birds of prey. As the aeroplane is sure to get on top of the dirigible eventually, the latter's fate seems sealed in French eyes. It is, however, interesting to probe the question more deeply. Altitude appears a deciding factor because it is assumed that an aeroplane can, by superior speed, easily get in position to hover "motionless" (relatively) right above the airship and annihilate it by merely dropping a bomb. The fallacy of this French reasoning rests on the comparative velocity of a machine gun's bullet and a dropping bomb's. In view of the airship's armament and the necessity for the aeroplane's flying with the same speed and in the same direction as the dirigible, in order to hit the quickly moving object, it is considered necessary that the bomb should be dropped from an elevation of no less than 2,000 feet above the airship. The calculations which permit an aeroplane while flying across the ground to hit a target with a bomb by properly considering and measuring its own speed relatively to the target and its distance from the ground, are no help in aiming at an airship. Only the aeroplane's own velocity need be considered in fighting an enemy on the ground, but the relative speed between an airship with a motion of its own and an aeroplane (and also the vertical distance) is such an indefinite quantity that no reasonable calculation can be based upon it. Nothing remained but to make use of the aeroplane's superior speed in obstinately hovering straight over the dirigible and "thus so far improving the aim that hitting became reasonably certain even at a vertical distance of 2,000 feet."

It remains to be seen how this theory works out in practice. The accuracy of the modern machine gun is such that in the opinion of military experts it does not sufficiently scatter its bullets; it absolutely depends on having the correct range. In this respect a company of infantry is better than a Maxim. But precious ammunition must never be wasted in the air by scattering the bullets, and "correct" range is "guaranteed," if the enemy can be hit point blank from a safe distance.

The invention of the steelclad "S bullet," pointed as sharply as an arrowhead, seems almost designed for aerial use. Indeed, it barely antedated the airship. It doubled the point-blank range which had already been pushed to 820 feet with the former blunt bullets. At very high angles the point-blank range is again doubled. Therefore, an aeroplane is in peril at any point of an extensive zone around, and especially above an armed Zeppelin. The latter's wonderful steadiness as a gun platform and the ever-increasing independence from range finding, uncertain in the air the higher the angle of fire, and the perfect accuracy of the modern machine rifle are formidable factors that must be reckoned with. It goes without saying, that the gun on top of a Zeppelin will be intrusted to the crack shot of a regiment.

To use dropping bombs against such a weapon seems like a return to the mediæval practice of pouring pails of boiling pitch. At a vertical range of two thousand feet, the distance of about seven city streets, it would not require exceptional skill to hit an aeroplane, in its broadest aspect, which has to remain more or less stationary with reference to the dirigible if it is to use its bomb effectively. A bomb requires thirteen seconds to drop 2,000 feet. Thirteen seconds is time enough to evade an unwelcome visitor from the sky.

In the clear air of the upper regions, a good pair of binoculars will enable a look-out on the steady dirigible to study in detail an aeroplane, "stationary" at 2,000 feet. The release of the bomb could no doubt be plainly seen (even in twilight with the help of the powerful searchlight now mounted on all big dirigibles) and an instantaneous electric signal to the helmsman will compel the airship to turn. Running sixty-nine feet a second, and, on account of the immense surface of the hull in proportion to the total weight, very quick to obey its rudder, it will be far from the point aimed at when the bomb at last arrives. But the airship will hardly make it so easy for the aeroplane to remain vertically above it. It will surely turn and circle all the time the aeroplane is trying to get at it. This will not interfere with its own fire (a bullet travels 2,436 feet a second in a practically straight line at very high angles, only an insignificant adjustment of the sights to the known relative wind being required) but will hopelessly disconcert the aim of the man who is directing the aeroplane's bombs. For this there are several reasons. The eye alone can hardly determine whether the aeroplane is fifty feet out of a vertical line of 2,000. The suspended telescope used by Lieut. Scott for more exactly aiming bombs begins to oscillate and fails utterly in zigzag flight. A bomb released during a turn flies wild, because centrifugal force does not allow it to drop vertically, and there is no way to ascertain the exact horizontal component of its trajectory. A bomb released between turns (if the airship should ever give such a chance to the aeroplane, which to stay right above it has to "copy" its every twist) is deflected because, after retardation by the turn, the airship's (and the aeroplane's) speed is not uniform, but accelerating. This, with the bomb's added retardation by the "relative" wind, is liable to drop the best aimed bomb behind the airship. Finally, without an automatically vertical telescope, unaffected by irregular flight, and also the highest skill in steering, it is impossible to remain straight above the constantly turning dirigible. The task is further complicated by the need of maintaining stability in the wind, to which need the dirigible is not subjected.

The fact that light aeroplane bombs of small mass and large surface are always deflected in passing through different wind strata, applies to all bomb work on aeroplanes. There is but one remedy—armoring the aeroplane's car, and getting nearer, even though it means destruction by the airship's explosion. But with a machine gun it is possible to fell a tree. The wings, which cannot be armored, are vulnerable spots. Armor, moreover, will surely compel the use of small cannon in place of machine rifles. The use of small cannon will also be the eventual result of the attempts to arm aeroplanes with machine rifles. Fighting it out with firearms on both sides will be the natural end of the present misplaced hawk-like tactics.

But if the airship mounts weapons which an aeroplane can also carry, it will, with its huge hulk, be at a disadvantage against a fleet of smaller aeroplanes. Naturally it must make good use of its capacity for mounting heavier pieces with longer range, and keep the aeroplanes at a safe distance. Then they will be shattered before their own weapons get into efficient range, because the heaviest cannon an airship can mount are almost as quick and handy as a rifle. We can depend upon seeing cannon appear on the large dirigibles in strict accordance with the stage of development of their adversaries, just as we saw machine guns appear, which are ample protection while aeroplanes have no worse intention than flying over the airship and dropping bombs. Lewis Oliver, who flew over besieged Adrianople, says: "It is no easy thing to regulate one's aim with bombs—I have tried it."

What Are the Ten Greatest Inventions of Our Time, and Why?

A Prize Article Contest Open to All Scientific American Readers

THE November Magazine Number of the SCIENTIFIC AMERICAN is to be devoted in part to a review of the great inventions of our time. Because a large number of SCIENTIFIC AMERICAN readers are either inventors or users of inventions, it seems to the Editors that their judgment of the inventions produced in our time which deserve to be called the greatest, their appraisal of the relative importance of the paramount technical achievements of our day, would be of peculiar value and interest. Therefore, it has been decided to leave the entire subject to them.

The publishers of the SCIENTIFIC AMERICAN offer three prizes of $150, $100 and $50, respectively, for the three best articles on the topic, "What Are the Ten Greatest Inventions of Our Time, and Why?"

Contestants for the prize must observe the following rules:

1. Each article must discuss and answer the following three questions:

a. What, in your estimation, are the ten greatest inventions produced within the last twenty-five years?

b. What are your reasons for this selection? Justify your selection in each case.

c. To what person or persons is the greatest credit due in the developing and perfecting of each invention which you have selected?

2. The entire subject must be covered in a typewritten article not exceeding 2,500 words in length, and must be treated as simply, lucidly and non-technically as possible.

3. In deciding what are the ten greatest inventions of our time, the contestants are limited to machines, devices and discoveries commercially introduced in the last twenty-five years.

4. Since the SCIENTIFIC AMERICAN is "the weekly journal of practical information," and its readers practical business men and inventors, the articles submitted should deal only with *patentable* inventions and discoveries.

5. In order to guide the contestant in deciding what is a great pioneer invention of our time, it is suggested that practical success and general usefulness to mankind be used as a test. A modern discovery may have been suggested long ago and its underlying theory even worked out mathematically, as in the case of wireless telegraphy, but nevertheless it falls within "our time," if it has been made generally accessible and useful within the last twenty-five years. But commercial success should not be the sole criterion. The flying machine has not yet added millions to the national wealth; but, for all that, it is a great invention of our time. Mere improvements on well-known and successful devices are not to be numbered among the great inventions of our time. Because an invention was first patented more than twenty-five years ago it is not necessarily debarred. The date of commercial introduction not the date of the patent governs. The invention, moreover, need not have been actually patented, but its subject matter must be of a patentable nature. Patentability is merely a test of commercial practicability.

6. Contestants must not disclose their identity. Each article must be signed with an assumed name and must be accompanied with a sealed envelope, on which the assumed name is written, and in which the real name and address of the author is contained.

7. Contestants must address their articles, accompanied by the envelopes containing their real names, to "The Invention Contest Editor of the SCIENTIFIC AMERICAN, 361 Broadway, New York city."

8. The articles will be passed upon by a Board of Judges, whose names will be announced in a future issue of the SCIENTIFIC AMERICAN.

9. The Board of Judges will receive only the articles submitted; the envelopes containing the true names and addresses of the authors will remain in the possession of the Editors of the SCIENTIFIC AMERICAN. When the judges have made their decision, the Editors will open the envelopes of the winning contestants and notify them of their success.

10. The decision of the judges will be announced in the SCIENTIFIC AMERICAN of November 1st, 1913. The prize-winning articles will be published in the order of merit in consecutive issues of the SCIENTIFIC AMERICAN, beginning with the issue of November 1st, 1913.

11. The Editors of the SCIENTIFIC AMERICAN reserve the right to publish in the SCIENTIFIC AMERICAN or the SCIENTIFIC AMERICAN SUPPLEMENT articles which have not been awarded prizes, but which are deemed worthy of honorable mention.

12. While contestants are not required to supply pictures with their articles, illustrations will be welcomed. If drawings are submitted, they need not be elaborate; the staff artists of the SCIENTIFIC AMERICAN will work them up for reproduction, provided the material supplied is intelligible. Do not send pictures torn from books and periodicals; they cannot always be reproduced satisfactorily, and their unauthorized reproduction may constitute a copyright infringement. If photographs marked "copyright" are sent, they should be accompanied with the copyright owner's written permission for their reproduction.

13. Members of the staff of Munn & Company, Incorporated, publishers of the SCIENTIFIC AMERICAN, and of Munn & Company, solicitors of patents, are excluded from the contest.

14. All articles will be received up to 5 P. M., September 1st, 1913.

The Problem of Fuel in France.—The French Automobile Club lately decided to appoint a technical commission for the purpose of looking into the matter of finding a new liquid fuel for internal-combustion motors and also of increasing the economy of running engines with the present fuels. The commission is headed by the Prince of Arenberg and contains well-known technicians such as De Knyff, Chasseloup-Laubat, Famechon and others. One of the questions which is being agitated of late is to provide a combustible of home production so as to be independent of other countries, especially in case of war.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Price Protection

To the Editor of the SCIENTIFIC AMERICAN:

This company believes in the principle of retail price maintenance because this is the best way to assure absolute fairness to consumer, retailer and manufacturer. Such maintenance does not mean monopoly and experience proves that well sustained prices on well-known and dependable products means lower and fairer cost to the user on general products.

Unfortunately trade conditions have not permitted us to put this principle into practice in our own lines; but this does not change our desire to accomplish it whenever possible.

THE LOWE BROTHERS COMPANY,
Dayton, Ohio. C. H. LOWE, Vice-President.

Price Cutting and Its Bad Effect

To the Editor of the SCIENTIFIC AMERICAN:

A dealer having the exclusive agency for an advertised line of goods (unpatented) usually undertakes and of necessity does carry a suitable stock of such goods; and as the manufacturer does not sell the same goods to anyone else in the same city, and does not himself sell goods direct to consumers at cut prices, the dealer is thus assured of his legitimate profit.

If, however, the manufacturer is compelled to sell other dealers in the same city, or is forbidden by law to fix the price at which the goods are to be sold, the dealer no longer has an incentive to carry a stock of goods, and in a short time it comes about that no one in that city will carry a stock of goods because there is no profit in handling them.

The invariable desire of the manufacturer is to make the selling price to the public, especially of unpatented goods, as low as possible, fixing the profit of the dealer as small as the dealer can be satisfied with, in order that his goods may move freely; and the effect of an exorbitant price is always disastrous to both the manufacturer and dealer, because it tends to diminish the sale of the goods.

GLOBE-WERNICKE COMPANY
Cincinnati, Ohio. H. C. GEISER, President.

Compulsory Licenses Under United States Patents

To the Editor of the SCIENTIFIC AMERICAN:

One of the provisions of the Oldfield patent bill that is now before Congress is for the compulsory granting of licenses under patents that are not being adequately worked. In this connection, it is interesting to recall that England has had a similar provision in operation since 1883. Under an act of that date, any person who could show that a patent was not being adequately worked in England, or that the reasonable requirements of the public with repsect to the invention covered by the patent were not being supplied, could compel the patentee, by proper suit, to grant him a license to manufacture under the patent. From 1883 to 1897 only three suits were filed asking for such licenses, and none of these ever proceeded to a hearing. Since 1897 a few suits have been brought, but generally speaking, there seems to be a disinclination to invoke the privileges of this law, due in some measure, no doubt, to the fact that a formal application for a license in such case would apparently carry with it an admission on the part of the applicant that the patent is valid and that the device he wishes to make is an infringement, and manufacturers are not prone to make such admissions. In most cases, it is preferable to endeavor to evade the terms of the patent and let the patentee be the complainant in a suit, thereby placing the burden of the litigation on the patentee, and placing the manufacturer in a better position to negotiate a license by compromise.

A later act (1907) amplified the earlier law somewhat by providing that the reasonable requirements of the public should be deemed not to be satisfied if any trade or industry is unfairly prejudiced by the patentee not manufacturing the patented device to an adequate extent or supplying it or granting licenses to manufacture it on reasonable terms, or by conditions attached by the patentee to the purchase, rental, or use of the patented device. Still, in 1908 there was only one petition filed under this law, and that was withdrawn by agreement between the parties.

The basic principles of patent jurisprudence being the same in this country as in England, it is reasonable to suppose that a law like the above would be of no more use here than it has proven to be in Great Britain. A law that has been practically a dead letter in England since it was put on the statute books in 1883 is certainly of no value on the statute books of the United States.

THE PACKARD MOTOR CAR COMPANY,
MILTON TIBBETTS, Patent Counsel.
Detroit, Mich.

Fixed Prices Protect the Consumer

To the Editor of the SCIENTIFIC AMERICAN:

The manufacturer must say at what price the retailer shall sell his product, and the law must compel the retailer to do this *to protect the consumer.*

How? Because stores cut prices on certain advertised articles to attract trade on other articles, sacrificing their profit on an advertised article to make it up on articles that yield an abnormal profit, i. e., a profit that will cover the loss on the advertised article cut.

Therefore the consumer has been misled and deceived. The manufacturer's business has been injured, for other retailers who desire to sell his goods at a living profit will not handle an article which they cannot sell at full profit.

Should two manufacturers of a similar article get together and agree to sell their goods at the same figure, that would be an act in restraint of trade. But when one manufacturer seeks to fix his own price, other manufacturers of the same thing may fix their prices a little lower, if they wish to.

YAWMAN & ERBE MANUFACTURING COMPANY,
Rochester, N. Y. PHILIP H. YAWMAN, President.

The Danger of a Distributing Trust

To the Editor of the SCIENTIFIC AMERICAN:

We believe that present American legislation and court decisions on price maintenance are made under a misapprehension of facts, and that the purposes which it is intended to accomplish by such activities will not be covered, but quite the reverse. All legislation along such lines has been advocated upon the ground that it would prevent monopolies and trusts from having undue profits. As a matter of fact, these great organizations will escape, because practically all of the great trusts have their own distribution. It will be the smaller concerns and those doing an honest and legitimate business, attempting to do nothing except protect their customers from unfair competition and to maintain the quality and standard of their products, who will suffer. It will be impossible for any person having a known brand and reputation for quality to maintain its quality if he is not allowed to protect the price at which such merchandise is resold. It will be used as a "football" and "catchpenny" by the great department stores and mail order houses, who ask nothing better than the opportunity to sell something of known standard for a less price than it can be sold at by anybody else, no matter whether they make a profit on it or not, in order to attract customers for less worthy merchandise.

There is fast arising in the United States a situation which it will be much more important for the Government to control than the producing trusts. The most oppressive of all trusts would be a distributing trust, which would have control of and tyrannize over all small producers. This is a condition which is not a figment of the imagination, but it does to a certain degree already exist, and the smaller tradesmen, who perform a great service for the community, and who make their living chiefly from standard merchandise of known merit and of standard price, are to-day in danger of being run out of business by price cutting of great department stores and mail order houses doing a cut-throat business. There are to-day in the United States five dry goods retailers who each distribute over $25,000,000 worth of merchandise a year, not to mention mail order houses that do a business covering everything from barbed wire to a handkerchief.

The real menace of the United States to-day is price cutting, not price maintenance. CHENEY BROTHERS,
South Manchester, Conn. By HORACE B. CHENEY.

Price Fixing and Competition

To the Editor of the SCIENTIFIC AMERICAN:

We are deeply interested in the question of maintaining uniform retail prices on advertised articles, whether patented or not, when the manufacturer thereof is subject to full and free competition. We believe this would be to the best interests of the public, the retail dealer, and the manufacturer. Our position agrees with that taken by Mr. L. S. Brandeis in an address delivered in New York May 14th at a dinner given by the Association of National Advertising Managers. It is summarized in the May magazine issue of the *Outlook*.

To illustrate: We have manufactured for half a century or more an instantaneous chocolate of unusual merit. This is sold to retail grocers at 62½ cents a pound, and the advertised retail price is 75 cents a pound, showing for the retailer a profit on his selling price of about 17 per cent. The majority of dealers do not sell this article, chiefly because the leading grocers for many years have sold it at "cut prices" ranging from 65 cents to 70 cents a pound. The stores that cut the advertised retail price are willing to sell instantaneous chocolate at a price that nets them a loss, when their cost of doing business is considered, making of course more than the average profit on articles that are not advertised and on which there is no standard price. The results of this condition are to prevent the wide distribution of this specialty, as the average dealer does not care to carry in stock an article that allows him less than a living profit, making it unprofitable for us to advertise it. This price cutting finally results in a failure to serve the large numbers of people who would be glad to purchase the chocolate at the fair competitive price of 75 cents a pound at the nearest grocery store. Please bear in mind that this price is *fair*, based upon the cost of producing the article, and is in direct and full competition with every other chocolate on the market. It happens to be the highest priced of all, but there is absolutely no reason for anyone paying the price except the unusual quality of the product.

We believe that when we sell this article by means of our own publicity campaign we should have the legal right to fix the retail price, and that the law should protect us, and the public and the average dealer against the price cutter.

But we expressly do not believe that any retail price should be protected that is not regulated by full and free competition. That is, we do not believe that manufacturers or trusts should be permitted to fix high prices by eliminating competition, nor should they be permitted by temporarily cutting prices to destroy the business of smaller competitors, their usual method of securing a monopoly.

STEPHEN F. WHITMAN & SON, INC.,
Philadelphia, Pa. J. W. WHEELOCK, Adv. Mgr.

The Birth-months of Genius

To the Editor of the SCIENTIFIC AMERICAN:

The influence of season upon the human embryo, in so far as concerns the mental and moral traits of the after-born individual, appears to have received scant attention at the hands of science. Its influence upon the physical organism seems not to have challenged over-much investigation. As a possible factor in sex-determination the subject has been considered, and the conclusion reached by Dusing and others that more males are born in the human family during the cold months of the year. That temperature, however, and seasonal changes may have many indirect and as yet unsuspected bearings upon embryonic life appears to be recognized by scientific writers.

As affording a basis for a future study of the influence of season, during the sensitive stages of the pre-natal life, not only upon the physical but upon the mental and moral being of the individual in after life, the present writer has tabulated the birth-months of the world's thousand most famous men and women, using for the purpose the list of names published by Prof. J. McKeen Cattell in the *Popular Science Monthly* for February, 1903. Of the thousand names, the information desired was afforded as to 431 by the authorities at the writer's command, and of these 45 were born in January, 40 in February, 34 in March, 36 in April, 38 in May, 26 in June, 29 in July, 34 in August, 36 in September, 36 in October, 41 in November, and 36 in December.

A tabulation by vocations of the names in our lists yields some curious results. Of the eminent personages connected with the church, for example, we find that 27 were born in the latter half as against 8 in the earlier half of the year, and much the same is true of poets, with whom the ratio is 25 to 15, and scientists, with whom the proportion is 30 to 24. On the other hand, 25 philosophers saw the light in the earlier half as against 15 in the latter half of the year, and in the case of statesmen the numbers are 25 to 20, in the case of military characters 22 to 13, in the case of musical composers 8 to 4, painters and sculptors 8 to 6, and in the case of writers, including historians but not including those classed in the biographical dictionaries as philo ophers, 26 to 25.

Not unlikely, these figures are merely accidental and without special significance. It is noteworthy, however, that the calendar of birth-months for men of genius, formulated thus from the writer's data, appears to answer closely to that for the ordinary population, for, according to Mulhall's "Dictionary of Statistics," the birth-averages, by months, for Europe are: January 107, February 107, March 107, April 103, May 99, June 94, July 93, August 95, September 101, October 99, November 97, December 98. Alike in our table and that of Mulhall, be it remarked, a decided diminution in number of births appears for June and July, and in both the earlier months of the year show a larger average than the closing months.

Fort Worth, Texas. CHARLES KASSEL.

The Electric Production of Steel

From the Early Experiments of Siemens to the Thirty-ton Furnace of To-day

IT is of course impossible, within the limits of the present article, to attempt an elaborate and detailed survey of the progress of the art of applying electric energy in the production of iron and steel. Our purpose is rather to give a brief *résumé*, commencing with the classic work of Siemens in the late seventies, and touching upon the more important steps by which the art has been brought up to its present degree of efficiency.

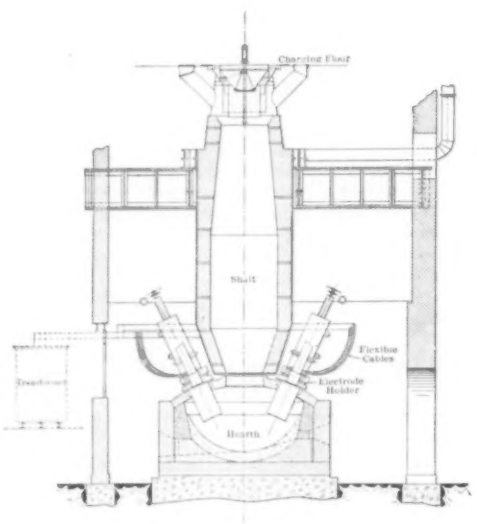
The importance of this latest development in the metallurgy of iron and steel is little understood by the general public, who may be surprised to learn that the electric furnace has been brought to a state of such efficiency that it is now possible to turn out a steel equal in quality to the costly crucible steel, in such quantities and at such a price that it is becoming available for many of the heavy trades which hitherto have been restricted to the use of Bessemer and open-hearth steel. The readers of the SCIENTIFIC AMERICAN will appreciate the significance of the above fact, when we state that steel rails are being made in commercial quantities from the high-grade steel which it is now possible to produce in the electric furnace, and that these rails, because of their purity, hardness and ductility, have shown in active service that they are well able to stand up under the heavier wheel loads and higher speeds of modern railway traffic, even under the severest conditions of winter temperature.

Mainly because the steel rail enters so largely into the question of safe railroad travel, we have mentioned this material as one of the heavier products that will benefit by the excellent qualities obtainable by electric refining. It must not be supposed, however, that the field of application of electric refining is limited to this, or to a few specialties. We have before us the statistics of the Heroult electric furnaces now in operation and building, and the kind of materials they produce; and from this we find that, among other products, they are turning out steel for the construction of war material such as guns, protective shields, projectiles, etc., and for locomotive tires and axles, seamless tubes, dynamo sheets, wire and wire rods, tool steel, high-grade castings, and other products calling for steel of high quality.

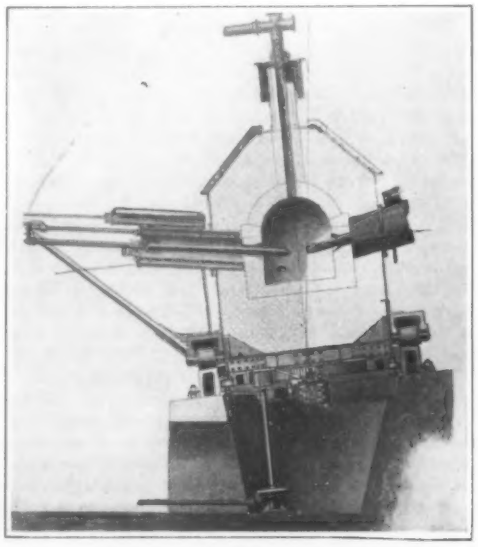
Until the appearance of the electric furnace, the process of making the bulk of the commercial steel for rails, beams, girders, plates, rods, etc., consisted in the smelting of the iron ore in the blast furnace, by charging the furnace with iron ore, coke and limestone, and reducing the ore by the fierce combustion of the charge under the action of a powerful hot blast. The molten iron was then rid of its impurities either in the Bessemer converter or in the open-hearth furnace, in the course of which treatment the steel was brought up to the proper composition by the further elimination of impurities and the regulation of the desired amount of carbon and other desirable constituents. Great as were the improvements effected by the introduction of the Bessemer converter and the open-hearth furnace, both as to the quantity and quality of the product, the further purification of the steel and the securing of the high-class material of the crucible process, without an undue increase in the cost, has been the goal at which the steel makers have aimed for many a decade past. It is largely because the electric process renders it possible to make steel in large quantities possessing the high qualities of crucible steel, that electric refining has proved such a valuable contribution to the metallurgy of steel.

SIR WILLIAM SIEMENS.—For the genesis of the electric refining furnace, we must go back some three decades and speak of the classic experiments of that noted inventor, Sir William Siemens, who foresaw the great possibilities of the electric furnace for steel manufacture. He built two furnaces, one of which was a crucible of graphite or some other refractory material, which was inclosed in an insulating jacket. One electrode was held in the bottom of the crucible and another passed through the cover and was provided with a device for maintaining it at the proper distance from the lower electrode. The metal was placed in the furnace and covered the lower electrode, and the arc was formed between this charge and the upper electrode. In his other furnace the two electrodes were placed horizontally and opposite one another, the arc melting the charge beneath it by radiation. As we shall see later, these two furnaces anticipated two of the modern, well-known, electric steel furnaces. Like many a famous inventor, Siemens was ahead of the state of the art; it is the modern development of electrical engineering that has made it possible to apply his system to the reduction of steel in commercial quantities.

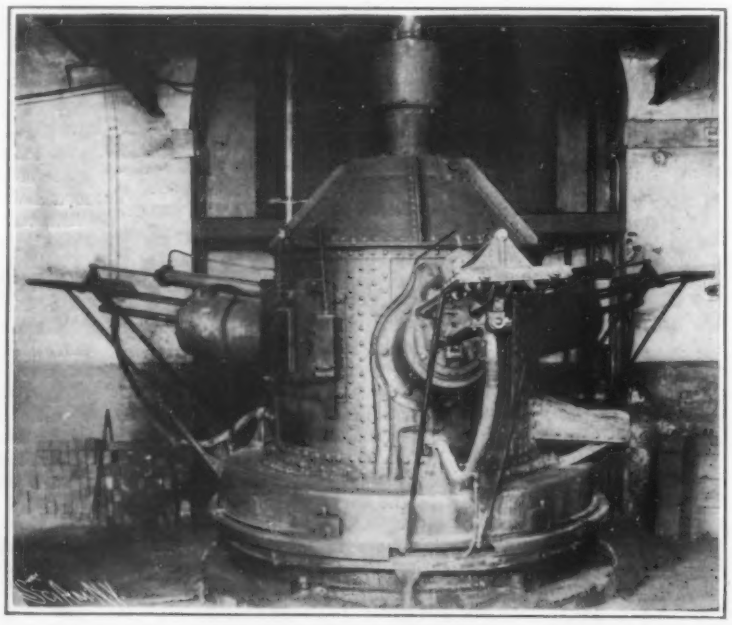
THE ELECTRIC SMELTING FURNACE.—When the development of electrical engineering had advanced to the point which warranted, or seemed to warrant, its application to steel making on a commercial scale, it was inevitable that the early efforts would be directed to the substitution of electrical energy for the fuel and hot blast of the smelting furnace; and the efforts of early inventors were directed mainly to the production of a successful electric smelter. Of this type was the Stassano furnace, the latest form of which is shown in the accompanying illustrations. This is a rotating furnace, which consists of a cylindrical steel casing, lined internally with firebrick, and rotates about an inclined axis upon a set of rollers. The charge consists of iron ore pulverized and made up, with charcoal and other necessary elements for reduction, into briquettes. The current is passed through the lower channel by contact rings, and projecting into the furnace are several electrodes whose position is regulated by means of cylinders, one of which is shown in section. As the gases are formed, they are led off through the top of the furnace. One of our illustrations shows an installation of this kind which is now at work in the government shops at Turin, for the melting of steel scrap.



Latest type of Swedish electric smelting furnace.



Section through Stassano furnace.



Stassano electric arc furnace at Turin, Italy.

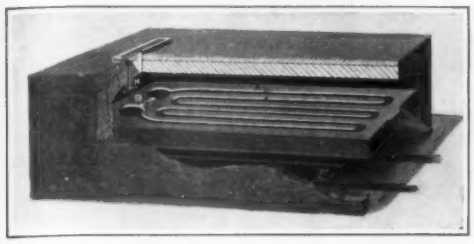
That there will be any world-wide substitution of the electric reduction furnace for the present blast furnace is unlikely. The change can be made profitably only in those localities where coal is dear and the production of electric energy is cheap. As matters now stand, if the electricity has to be generated through the medium of coal-fired boilers, steam engines and dynamos, the electric smelter cannot possibly compete with the blast furnace; but it has been proved, notably in Sweden and also in California, where fuel is relatively dear and the supply of electricity generated in hydro-electric works is abundant and cheap, that excellent pig iron may be produced successfully on a commercial scale.

The Noble Electric Steel Company of California, where charcoal is obtained at low cost, are using successfully an oblong furnace with four electrodes projecting downwardly from the roof of the furnace. The Swedish reducing furnace follows in construction the general lines of the blast furnace, the charge being introduced at the top and the hot metal being tapped off at the bottom. The place of the hearth of the blast furnace is taken by a domed receptacle built at the bottom of the furnace, through the roof of which from two to six electrodes project diagonally into the furnace. That the Swedish works are producing pig iron on a commercial scale is shown by the fact that last year the total output was about 29,000 tons.

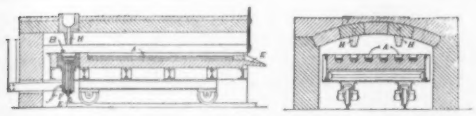
ELECTRIC REFINING FURNACES.—The field of electricity in the manufacture of steel will be confined mainly, for the present at least, to the refining of steel. For this work the various furnaces may be divided under three types: First, those in which the heat is produced by the resistance of the metal in the bath, a type which has never passed the experimental stage; second, those in which the heat is due to electric current induced in the bath; and, thirdly, those in which the metal is heated by an electric arc (either by direct contact of the arc with the metal or by radiation from a super-imposed arc). Of the three types, the electric-arc furnace is the most successful, and it is in such extensive use as to warrant the belief that at least for the refining of steel it may ultimately have exclusive command of the field. The induction furnace, which was formerly a promising rival, has done good work and is still in use in some of the more important works, particularly in Germany. The resistance furnace has gone very little beyond the experimental stage in the refining of steel.

THE GIN RESISTANCE FURNACE.—The Gin furnace, as shown in our illustration, consists of a car, upon which is constructed a furnace of masonry, provided with a long serpentine channel *A*, connected with electric pole pieces at *B*. This channel is filled with the metal to be treated through hoppers *H*. The desired temperature for treatment is obtained by varying the current passing into the hot metal in the bath.

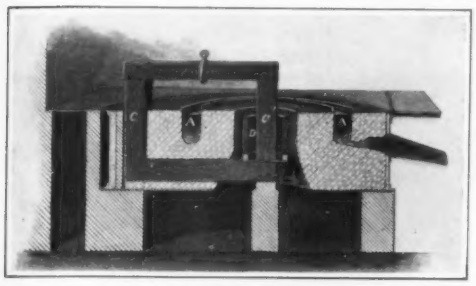
THE KJELLIN INDUCTION FURNACE.—The induction furnace, of which the Kjellin, shown in the accompanying illustration, is a well known example, is practically a large crucible free from electrodes in which the steel is heated by



The Gin resistance furnace, an early experimental type.



Sections through Gin furnace.



Kjellin induction furnace.

an induced current. The charge is protected from the action of any furnace gases and from oxidation. This furnace consists of an annular hearth *A* formed in the masonry body of the furnace; an iron core *C*, one arm of which passes through a central hole formed within the annular hearth, this arm being surrounded by a primary coil *D*. The charge in the annular hearth *A* is maintained at the desired temperature by varying the current through the primary coil *D*. The furnace is closed by removable cover plates, not shown in our drawing.

THE RÖCHLING-RODENHAUSER INDUCTION FURNACE.—The Kjellin furnace above described is necessarily of limited capacity, and both its diameter and cross section must be increased if there is to be an increase of the charge. If the cross section is increased, the electrical resistance would not be sufficient to obtain the necessary working temperature. If the diameter is increased, the distance between the primary and secondary windings and the magnet coil would likewise be augmented in proportion and the losses due to dispersion would be increased. These difficulties were sought to be overcome in Germany by Röchling and Rodenhauser, and in Norway by Hiorth.

The Röchling and Rodenhauser furnace, like the Kjellin, is of the induction type, but with a single primary winding *A* around each iron core. The bath is in the form of a figure 8, with that portion of it *D* lying between the two cores of much greater width than that *C* lying outside of it. The secondaries are two; one being the molten metal, and the other a copper winding *B*, which is connected with metal plates *E* in the furnace walls. The current passes from *B* through *E* and a mass *G* of highly refractory electric conductors, to the metal *D* in the bath. The metal is thus subjected to heating effects both by direct induction and by the current passing through the bath, between the opposite sets of electrodes *E*.

HEROULT ELECTRIC FURNACES IN OPERATION OR BUILDING, MARCH 1ST, 1913.

	Number of furnaces—Building.	Operating.	Production in tons per year.
Germany	6	13	425,750
United States	4	9	164,500
England	3	4	77,500
Austria	3	4	46,500
Italy	2	2	41,000
Belgium	2	..	30,000
Russia	..	3	30,000
France	1	2	11,500
Sweden	..	1	3,000
Switzerland	..	1	2,500
Hungary	..	2	1,500
	21	41	833,750

THE HEROULT ELECTRIC ARC FURNACE.—We have so recently (SCIENTIFIC AMERICAN, June 7th, 1913) described the 15-ton Heroult furnace as installed by the United States Steel Corporation at their works at South Chicago and at Worcester, Mass., that a brief reference will suffice in the present article. The Heroult furnace is broadly similar in its construction to an open-hearth furnace. It is so supported as to have a tilting motion from the charging to the pouring side. The necessary temperature is secured by the fierce heat of an electric arc formed between electrodes and the metal bath. The electrodes pass through the roof of the furnace and are maintained at the required distance above the hot metal by automatic, electrically-controlled devices.

The phosphorus is removed in the basic electric furnace in much the same manner as it now is in the basic open-hearth furnace—by the use of lime and oxide of iron. The resulting slag containing the phosphorus is tapped off, and a new slag of burned lime and fluor spar is formed. When the slag is molten, coke dust is added, and the resultant carbide of calcium is produced. The free carbon, and, possibly, the carbide of calcium in the slag, with the aid of the carbon and manganese in the bath, eliminate the deleterious oxygen from the steel.

The advantage of this process of refining is, that the resulting steel is free from segregation, is almost perfect in structure, and shows no oxide or slag inclosures under the microscope. A similar furnace is in successful operation at Worcester, Mass.

That the electric furnace of large size is capable of turning out large quantities of steel, such for instance as are required for rail manufacture, is shown by the results obtained by the United States Steel Corporation, who, by the way, have expended in their experimental work, to date, over $800,000. They have already produced about 10,000 tons of electrically-refined steel rail, and most of it has been in service for the past three and one half years. During that time there has not been a single case of breakage, the steel, in addition to its purity, showing a remarkable toughness.

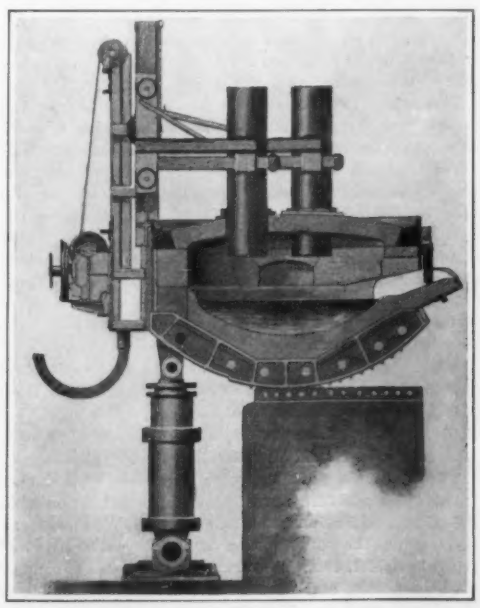
The great strides which have been made in electrical refining during the past few years are shown by the table published on this page, from which it is seen that Germany heads the list with an annual output of 425,750 tons of electrically-refined steel, followed by the United States with 164,500 tons, the total output being 833,750 tons for the world. This for the Heroult furnace alone; and if to these totals are added those for electric furnaces of all kinds, it is found that the annual output has already reached the remarkable total of over one million three hundred thousand tons.

The Measurement of Lights of Different Colors

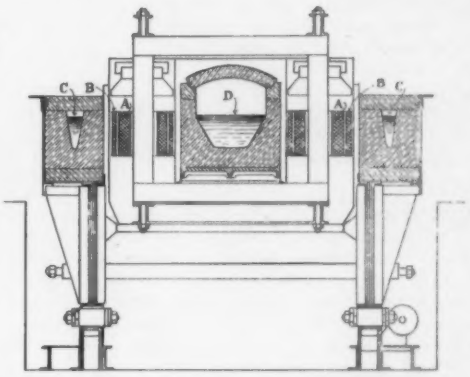
PROF. HERBERT E. IVES in two learned technical articles which have appeared in the *Philosophical Magazine* gives the result of an investigation into the photometric effects of lights of different colors. His results are interesting enough to present in a popular account.

The advent of incandescent lamps of great efficiency and other new lights with a wide range of color, the prospect of an even larger variety in the near future which will diverge in tint still further from present illuminants, all render the problem of measuring the luminosity of various hues, one of great importance. The mere comparison of two differently colored lights, is no more possible than is the exact comparison of sound with odor. Some methods, of course, have been discovered which in the process of measurement evade or eliminate the differences in hue. But different methods require different standards and Dr. Ives proposes to obtain a relation between the various criteria.

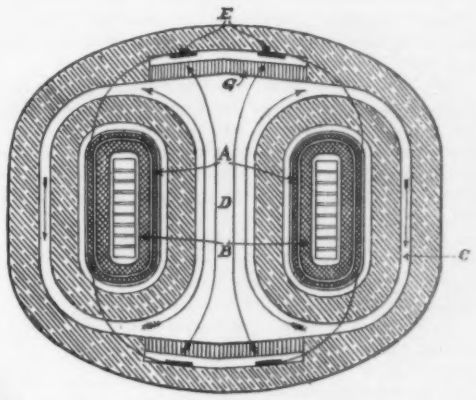
The chief obstacle, he says, in the way of giving preference to one method over another is a woeful want



The Heroult 15-ton arc furnace at South Chicago, Ill., and Worcester, Mass.



Cross-section through Röchling-Rodenhauser furnace.



Horizontal section through Röchling-Rodenhauser induction furnace.

of statistics or data. These defects Dr. Herbert Ives proposes to remedy. Of the methods of light measurement which have been applied to differently colored lights, one is the method of equality of brightness. Two colored lights illuminate two portions of a background or photometric—measure of light—screen. The relative intensities of illumination from the two lights are changed until the two differently colored fields give a sensation of equal brightness. The illuminations are then said to be equal.

The method of acuity of sight is merely the way of proving two colors equal when the same fineness of detail is just distinguishable by each, while the method of critical frequency holds that two illuminations are equal when the flicker produced by rapid alteration of one illumination with black disappears at the same speed of alternation as the other.

Two illuminants are also said to be equal when upon rapidly alternating one with the other no sensation of flicker results. The speed of alternation is such that the slightest change of either will cause a flicker.

Dr. Ives discovered that the best standard must center around the flicker and the equality of brightness of the colors. So he then determined by the two methods the degrees of luminosity of the various tints and colors of the spectrum. The original findings of his numerous experiments are most helpful.

He found that the flicker method is much more sensitive than the equality of brightness method, particularly where colored lights are concerned. The result with the flicker method is more easily reproduced than with the equality of brightness plan. While decrease of illumination shifts the maximum of luminosity toward the blue in the equality of brightness method, yet with the flicker method it shifts toward the red.

Decrease in the size of the measured field of light in low illuminations, shifts the maximum of luminosity toward the red for the equality of brightness—called the yellow spot effect—and toward the blue with the flicker method. The results are also most different at low degrees of illuminations upon large fields. They are nearest together at high illuminations and a small surface or field of light.

With the hope of shedding some light on the peculiarities of the flicker method, other experiments were carried out. Dr. Ives' results has served to clear up the seeming discrepancies of various observers, and these were brought into accord by proving that a change in experimental conditions yields changes in the results.

He also shows that the retina is found to be more sensitive to flicker farthest away from its central point, only on momentary observation before fatigue or adaptation sets in. The point of best vision—the fovea—is more sensitive to red flicker, the periphery or outside part of the retina, is more sensitive to blue lights. These differences are greatest at low degrees of illumination.

The Heavens in August

The Summer Constellations; Jupiter's Satellites

By Henry Norris Russell, Ph.D.

So far as predictable events are concerned, there will be little to attract the attention of the American amateur in astronomy during the coming month. There is, to be sure, a partial eclipse of the Sun on August 31st; but the Moon is then so far north of the plane of the Earth's orbit that the central line of her shadow misses the Earth by about 1,500 miles, and only the southern edge of the penumbra (the region of partial shadow, from which only a fraction of the Sun's light is excluded) sweeps across the northern portion of our planet. The region from which the eclipse is visible is therefore unusually small, including only Greenland, Iceland, Labrador, Newfoundland, and the adjacent seas, with the extreme northern portions of Nova Scotia and New Brunswick.

The Sun, as seen from all these regions, will be low in the west at the time of eclipse, and little more than one tenth of his diameter will be obscured. Nevertheless, granting clear weather, the eclipse should be distinctly observable in Newfoundland, beginning a little after 5 P. M. by Atlantic time (which is kept by the railways there), and lasting about half an hour. On the southern shores of the Gulf of St. Lawrence the eclipse will be almost vanishingly small, but the very shallow notch in the Sun's northern limb may be observed with a field-glass (protecting the eyes by smoked glasses) at about 5:25 P. M. by Atlantic time (or 4:25 by Eastern Standard time).

Unless the reader's holiday may happen to take him thus far afield, he will have to confine his studies to the stars, and to the planets Jupiter and Uranus; but there is no lack of interest here.

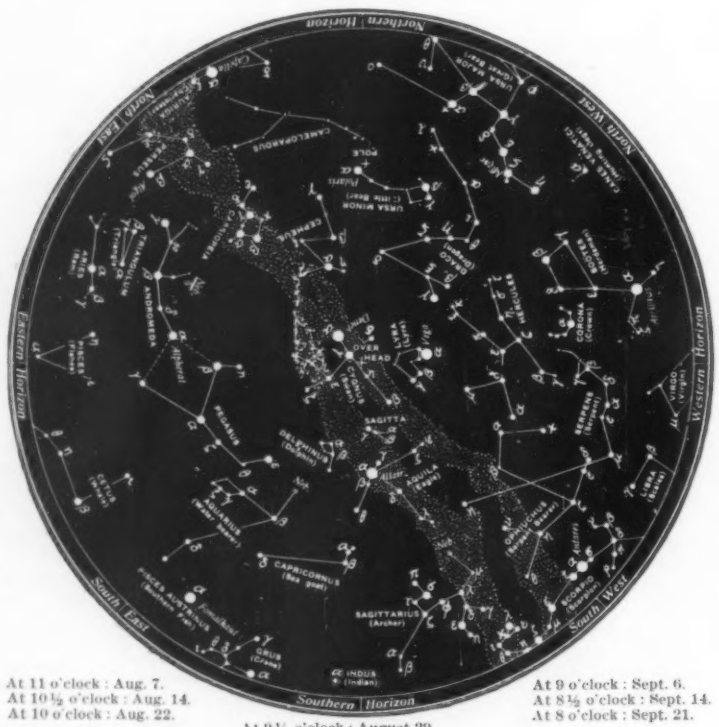
Our map shows what stars are to be seen in the evening skies, and just where to look for them at the hour given below it. At an earlier hour all the stars (except those in the north below the pole) will be farther to the east; i. e., they will be higher up if in the western sky, lower down if in the east, and more to the left if in the south, and so on.

The student whose wish is to become familiar with the summer constellations may begin by looking straight overhead. Here he will see the Milky Way stretching from northeast to southwest right across the sky, and in it a large and conspicuous cross of stars of which the brightest is at the head of the figure. This is the constellation Cygnus—the Swan. It takes very little imagination to see the actual figure of a bird in this group of stars, the brightest star making its head, the arms of the cross extended farther by other stars, its wings, and the foot of the cross its tail. With this as a starting point we may proceed in any direction. The line of the Swan's wings, extended toward the northwest, points to two bright stars, not far apart, which form the eyes of the Dragon. (β and γ in Draco on the map.) Much lower down, in the same line, we come to the handle of the Great Dipper; or, if we prefer, the tail of the Great Bear.

If now we hold our map so that the Dipper is at the bottom, we can pick out at once every bright star in this part of the sky, find to what constellation it belongs, and what Greek letter has been assigned to it, and trace the outlines of the constellation. In the same way we may proceed in any other direction from our starting point, finding in the west the two very bright stars Vega (high up) and Arcturus (low down); in the southwest the constellations Scorpio, now very low, and Sagittarius; in the south, higher up, Altair and the other stars of the Eagle, and below it the fainter pair which mark the head of Capricornus; in the southeast the isolated bright star Fomalhaut; in the east the Great Square of Pegasus standing on one corner; and in the northeast Cassiopeia and Perseus, both in the Milky Way, and the latter just rising. The less conspicuous constellations may now be identified with the aid of the map.

The observer who has a field-glass at his command will find interesting objects in the stars ζ in Ursa Major, and α and β in Capricornus, all of which are double. The first two can be easily separated by the naked eye, but the third, whose companion is much fainter, requires optical aid. About half-way between α and δ in Cygnus is another pretty pair, and a second is close to the bright star Vega. The Great Nebula in Andromeda (shown on the map) is also easy to find, and there are fine star-clusters in the Milky Way between Cassiopeia and Perseus, and in Sagittarius.

Most interesting of all is the great planet Jupiter, which, though low in the southern sky, among the stars of Sagittarius, outshines all else. This great brightness makes Jupiter a very striking object, even in a field-glass. It takes a powerful binocular, good focusing, a steady hand, and a trained eye, to see the planet's disk distinctly; but the satellites, especially the two outer of the four, are not hard to see. The beginner need not be alarmed, however, if on the first night when he observes Jupiter, he can see no moons near it, or perhaps only one; for if the satellites are nearly in front of the planet or behind it, it takes a more powerful instrument to reveal them. A little patience, however, in watching the planet on successive nights will be rewarded. The third satellite, which is the brightest of all, can be seen on the east of the planet on August 1st, 8th, 15th, etc., and on the west on the 5th, 12th, 19th, etc., its period of revolution being 7 days 4 hours. The fourth, which is fainter, but goes almost twice as far from the planet, may be seen on the east side on the 2d and 19th, and on the west side on the 11th and 27th, and for some three days on either side of these dates, its period being 16¾ days.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.
At 9½ o'clock: August 29.
At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

NIGHT SKY: AUGUST AND SEPTEMBER.

The other two satellites are so much nearer the planet that they are not as easy to see with a small glass; and their periods are so much shorter that it is harder to keep track of them. The second satellite, which completes a revolution in 3 days 13 hours 18 minutes, is on the east of the planet at 11 P. M. on the 3rd, 1 A. M. on the 9th, etc. The first, whose period is only 1 day 18 hours 28 minutes, is at its eastern elongation at 2:10 A. M. on the morning of the 2nd, 8:38 P. M. on the evening of the 3rd, etc.; and, of course, west of the planet at the moments just half-way between these.

With this information, the observer may easily find out which satellites were observable at any given time. All calculation can be avoided by recourse to the *Nautical Almanac*, which gives diagrams showing exactly where to look for all four satellites every night.

The fortunate possessor of a telescope three inches or more in aperture may find still greater interest in the study of Jupiter and his system. With such an instrument, the vital forms of the planet's disk and the belts which cross his surface parallel to the equator are easily seen, and with a little care, it is possible to watch the passage of markings across the surface, as they are carried round by the planet's rapid rotation.

The eclipses and transits of the satellites are fascinating, too. The approach of a satellite to the edge of Jupiter, and its disappearance into, or reappearance from, the planet's shadow, can be watched with a small instrument. It takes a larger telescope to see the shadows of the satellites, as tiny black dots crossing the planet's disk, and a still more powerful one to see anything of the satellites themselves when in front of the planet. During the present month, the phenomena observable in the evening in the eastern part of the United States are as follows:

SATELLITE I.

Is in front of Jupiter on:
August 7th, from 6:51 to 9:09.
August 14th, from 8:39 to 10:57.
August 21st, from 10:27 to 12:45.
August 23rd, from 4:54 to 7:12.
August 30th, from 6:44 to 9:02.

Is behind him, or in his shadow, on:
August 6th, from 9:47 to 12:45.
August 13th, from 11:30 to 2:39.
August 15th, from 5:57 to 9:08.
August 22nd, from 7:45 to 11:03.
August 29th, from 9:35 to 12:58.
August 31st, from 4:02 to 7:26.

SATELLITE II.

Is in front of Jupiter on:
August 4th, from 7:25 to 10:15.
August 11th, from 9:44 to 12:34.
August 18th, from 12:05 to 2:55.

Is behind him, or in his shadow, on:
August 13th, from 3:54 to 8:30.
August 20th, from 6:17 to 11:07.
August 27th, from 8:42 to 1:45.

Satellite III. comes out of eclipse at 11:20 on the 7th, goes behind the planet at 8:35 on the 14th, comes out again at 11:51, and disappears into the shadow (which, as seen from the Earth, lies on one side of Jupiter) at 12:17 the same night. It may also be observed to disappear behind the planet at 12:07 on the 21st.

Satellite IV. can be seen going into eclipse at 11:38 on the 15th, and going in front of the planet at 10:28 on the 23rd.

All the times in the above table are given (as in the *Nautical Almanac*) in Washington time, which is eight minutes slow on Eastern Standard time. It will be seen that the most interesting date of observation is the 14th, when two satellites are hidden at once, the first in front of Jupiter and the third behind him.

The planet Uranus is now also very well placed for observation, his position on August 2nd being in 20 hours 31 minutes 44 seconds of right ascension, and 19 degrees 33 minutes south declination, while that on the 30th is 20 hours 27 minutes 29 seconds; — 19 degrees 48 minutes. Observers not provided with detailed star maps may easily find him with the aid of three small stars in Capricornus, which may be found by drawing a line from α through β Capricorni, and prolonging it to the southward not quite twice the distance between them. These three stars, o, π and ρ Capricorni, form a nearly equilateral triangle. Due east of them, at about the same distance as that between α and β Capricorni, is another faint star, υ Capricorni.

All these stars are between magnitudes 5 and 5½. Uranus is of the 6th magnitude—a little fainter—and lies about 1 degree south of the line joining υ Capricorni to the triangle. The lower side of the triangle points almost straight at him. At the beginning of the month he is about twice as far from the triangle as from υ, but at its end he is nearer the former. He can only be seen with the naked eye on a very clear dark night, but is conspicuous in a field-glass. The neighborhood of these good reference stars makes this an unusually good time to hunt for the planet.

Of the other planets, Mercury is in conjunction with the Sun on the 3rd, and cannot be seen until the latter part of the month, when he appears as a morning star, in Cancer, rising before 4 A. M. He is at his greatest apparent distance from the Sun, 18 degrees 26 minutes, on the 22nd, and should be easily visible.

Venus is morning star in Gemini, rising about 2 A. M. and exceedingly bright. Mars is likewise a morning star, in Taurus, rising about midnight, and appearing a little brighter than Aldebaran. Saturn is close by;

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Canoe Driven by an Air Propeller

IN the waters about Mamaroneck, New York, there appeared recently a canoe driven by an aeroplane propeller. This odd craft was built by Joseph Bister, and with it he has made a speed of 15 miles per hour. The canoe is 18 feet long. In the forward end there is a light framework which supports the propeller shaft. The shaft carries a 5-foot aeroplane propeller which is driven at 800 revolutions per minute by a 7 horse-power twin-cylinder engine. The propeller shaft is belt-connected to the engine shaft. In order to give the canoe sufficient stability it is provided with pontoons, one at each side, as shown in the illustrations. The pontoons aid in balancing the canoe when the engine is being cranked, but when the canoe is under way they just clear the water. The builder of this craft has given it the name, "air-canoe."

Canoe driven by an air propeller.

Cody and His Proposed Transatlantic Flight

IN an endeavor to capture the *London Daily Mail's* prize of $50,000 for the first aviator to cross the Atlantic within 72 hours, Col. F. S. Cody, the well-known Anglo-American airman, is building a hydro-aeroplane in which he hopes to cross the ocean in 20 hours. In order to do this he will have to average at least 90 miles per hour and cross at the narrowest part, which lies between England and Newfoundland.

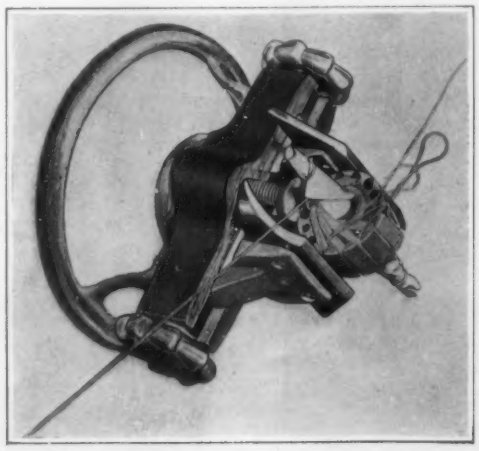
It is believed by those who have made a study of the question that the first flight will be made without a stop, as the high waves of mid-ocean would prove disastrous to flying machines of the present day. The problem of deciding from which side of the water to start is also occupying the attention of those airmen who intend to compete for the prize. Starting from England, a flyer would travel with the sun and would have daylight for about 22 hours, while a start from Newfoundland would give him only 14 hours of light. However, he would have the advantage of the prevailing western winds in mid-ocean.

Richard Börnstein

THE death of Prof. Richard Börnstein on May 13th removed a conspicuous figure from the circle of German meteorologists. Although he was professor of physics at the agricultural high school of Wilmersdorf (a suburb of Berlin) he had for years devoted his attention almost wholly to meteorology, especially the practical side of the subject. To his efforts chiefly was due the organization in Germany a few years ago of a system of weather-forecasting and map-publishing stations analogous to those of the United States Weather Bureau. Among his voluminous writings was an admirable elementary textbook of meteorology, a new edition of which had just appeared at the time of his death. For many years Börnstein was editor of the first two of the three annual volumes of the "Fortschritte der Physik"—a publication that is indispensable to every worker in the physical sciences. He was a member of the recently organized International Commission on Agricultural Meteorology.

Armature-winding Machine

A RESIDENT of St. Louis, who for years has been engaged in the electrical repair business, has recently built a machine for rewinding small armatures. The device takes either diametrical or chord windings in either straight, twisted, open or overhung slots, and it may be adjusted to the armature in two or three minutes. It consists essentially of a universal two-jaw chuck which holds the armature while it is being wound. The jaws are shaped to guide the wire into the slot. Between the jaws are two screw stops which are adjusted to fix the point at which the jaws grip the armature coil, so that when the slot on one side is set and the core is held against the stops, the other slot will line up with the opposite jaw. The jaws are tightened upon the armature by means of wrench wheels of such proportions that the operator cannot readily exert too much pressure on the delicate core and damage the teeth. The machine in operation may be slipped on the shaft of a small motor, say 1/6 horsepower, at 300 to 400 revolutions per minute, and preferably it should be provided with a foot controller such as used on sewing machine motors. The device may also be driven by a treadle or by hand power with a step-up ratio of say three to one. By means of a revolution counter a record is had of the turns of wire. After the machine has been adjusted for a certain armature, the latter is gripped with the edges of the jaws overhanging the teeth of the slots a trifle. The device is then turned and the wire is automatically fed into the proper slot. When the first coil is finished, the wrench wheels are loosened, and the core is turned to the next slot; when the next coil is wound, and so on, until the entire winding is completed. For armatures with twisted slots the jaws may be adjusted to the proper angle. With a device of this kind repair work on small armatures, which formerly had to be done by hand, is now greatly expedited.



Automatic armature-winding machine.

The Tin-plate and Terne-plate Industry

STATISTICS for the tin-plate and terne-plate industry in the United States for 1909 are presented in detail in a bulletin soon to be issued by Director Harris of the Bureau of the Census, Department of Commerce. It was prepared under the supervision of William M. Steuart, chief statistician for manufactures.

Tin-plates are thin plates or sheets of steel or iron, known as black plates, coated by dipping in a bath of molten tin. Terne-plates are black plates coated, in like manner, with an alloy of tin and lead known as terne mixture, the proportion of tin varying from 10 to 35 per cent. The term "terne" is taken from the French, and means dull or tarnished. On account of the lead in the mixture terne-plates are much duller in appearance than tin-plates, sometimes known as bright plates.

Tin-plate manufacture involves two radically different processes—the rolling of the black plates and the dipping of them in tin or terne mixture. The manufacture of black plate is a rolling-mill operation, and the bulk of the dipping is performed by the dipping departments of such rolling mills.

Of the 34 establishments in the combined industry in the United States in 1909, 27 both rolled black plates and dipped them, three rolled black plates but had no dipping departments, while four were engaged in tin and terne dipping only. The number of each of these groups of establishments was smaller in 1909 than in 1899; but the decrease was greatest in the number doing a dipping business only, and the number making black plates with no dipping departments. There has been a growing tendency to consolidate the two branches of the business.

The net value of all products of the black-plate mills and dipping establishments in 1909 was $65,378,580, of which amount the value of tin and terne plates represented 70.1 per cent. In 1904 the value of the tin and terne-plate product formed 80.9 per cent of the net value of all products of these establishments, and in 1899, 75.7 per cent. The value of products of the industry in 1909 was 58.2 per cent greater than in 1899. The value added by manufacture—that is, value of products less cost of materials—was $22,948,150 in 1909, and the number of wage earners, 18,956.

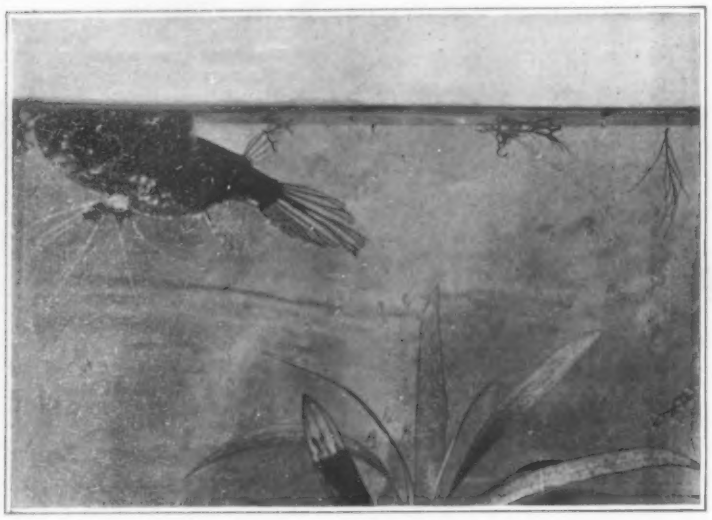
Higher Electric Lamp Efficiency

NEW incandescent lamps which contain especially shaped tungsten filaments and are filled with nitrogen at a pressure of about an atmosphere, will soon be obtainable. The types which it is expected to develop first are adapted to comparatively high current consumption, six amperes and above, and operate at an efficiency of half a watt per candle-power. This is fully twice as high an efficiency as the most efficient incandescent lamps heretofore available. The new lamps promise to be of particular value in a field not heretofore covered by incandescent lamps, and should greatly broaden the applications in which they can be used advantageously, particularly in the direction of very large candle-power units.

The Cost of Orchard Heating

THIS is the subject of some elaborate statistics by J. C. Alter, in the *Monthly Weather Review*, partially answering the question "Does frost fighting pay in Utah?" Assuming 30 degrees as the temperature below which heating is necessary, he finds that for the first degree—i. e., to heat from 29 to 30 degrees—the cost is 60 cents per acre per hour, while with a further fall of temperature the cost increases 40 cents per degree per acre per hour. Thus to heat the orchard to the safety mark with a temperature of 20 degrees the cost is $4.20 per acre per hour. It is also assumed that if the temperature falls below 20 degrees, the crop cannot be saved; and this may happen after a large amount of fuel has been expended. Again, the business of firing presents many chances for small leaks of one sort or another, and much unnecessary firing is apt to be done in the attempt to err, if at all, on the safe side. Finally, there is the question whether the soot-laden and smoke-covered pollen can continue its work of fertilization. Some of the growers who in the past have "successfully" fired their orchards have now abandoned the practice. On the whole, Mr. Alter's deductions are discouraging, so far as his observations in Utah extend, but of course do not, necessarily, apply to other parts of the country, where frosts are less frequent and severe, or where fuel and labor are less expensive.

Earthquakes and Rainfall.—It has been conjectured that excessive atmospheric precipitation might favor the occurrence of earthquakes by increasing the supply of subterranean water, leading to a washing away and collapse of portions of the earth's crust. Count de Montessus de Ballore has published in the *Comptes Rendus* the results of a painstaking comparison between 4,136 earthquakes and the rainfall conditions preceding them. He concludes that there is no relation of cause and effect between these phenomena.



Pantodon, or African flying fish.

Brazilian moon fish (*Pterophyllum scalare*).

Curious Exotic Fishes

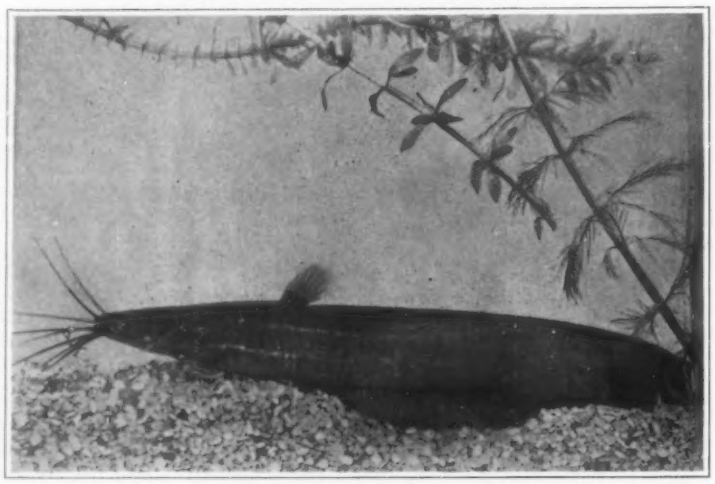
By Jacques Boyer

THE breeding and keeping of small exotic fishes of strange forms, striking colors and curious habits has been greatly promoted in Germany, in recent years, by the efforts of enterprising Hamburg importers. At present several French pisciculturists are endeavoring to make this custom, of Chinese and Japanese origin, popular in France.

The aquariums of M. Lefèvre, in particular, are filled with rare and superb specimens, brought from China, Japan, Africa and South America, some of which we have succeeded, though not without difficulty, in photographing in characteristic attitudes.

Let us first examine the telescope fish, which Carbonnier tried to acclimate in France forty years ago. This monstrous variety of carp, a creation of the Chinese and Japanese fish breeders, who are past masters in the art of deforming nature, has an almost globular glistening body, gilded on the sides, double dorsal fins and a long tail of peculiar shape. Its eyes and their sockets are very prominent and resemble the object glasses of telescopes, whence the name telescope fish. A carp possessing this abnormal feature was discovered in Japan in the sixteenth century, since which epoch the peculiar character has been perpetuated and combined with many variations in form and coloring, by careful selection and crossing. By these means, combined with ingenious processes and devices which it would be tedious to describe in detail, the Japanese breeders have succeeded in preserving various individual peculiarities. In order to increase the protuberance of the eyes, for example, the fishes are kept in an aquarium which is dimly illuminated by light coming from a single point. The eyes of the young fry are normally formed.

A Japanese telescope fish, the "fan tail."



Bengalese catfish (*Sacobranchus singio*).

The variety known as Yen-tan-yen or "veil tail" preserves the normal structure of the eye during life, but its delicate, transparent tail attains an enormous size and falls in graceful folds, like a veil, producing effects that a "serpentine" dancer might envy, when the little fish moves in the sunlight.

Other Japanese varieties of the telescope fish are the "sheep's nose," which owes its name to the convexity of its body; the "pig's snout," which has a head resembling those of Asiatic swine, and the "fan tail," which raises and spreads its tail in the manner of a fan-tail pigeon.

The Chinese breeders of telescope fish disdain these abnormalities of structure and devote their attention chiefly to coloring. By modifying the temperature of the water, and by impregnating it with lime and iron, they produce startling shades and markings. Among the innumerable varieties thus obtained we may mention the "spotted," with a belly of silver, and sides and back marked with blue, yellow, black, rose and carmine dots; the crimson "ruby" and the "superb," with gilt-edged scales, scarlet belly, and black or bright red markings on the back.

The globular form of all telescope fishes makes their equilibrium very unstable and their movement awkward. They are very subject to malformation of the swim-bladder. Some individuals swim on one side, others on the back, because of displacement or atrophy of that organ. Some, called "tumblers," perform somersaults like tumbler pigeons, others remain at the bottom of the water. In the case of hypertrophy of the swim-bladder, on the other hand, the fish remains at the surface.

Telescope fishes breed well in captivity, but as they devour their offspring they should be removed as soon as the eggs are laid. The young fry are fed, first with dried and pulverized silkworm pupæ,

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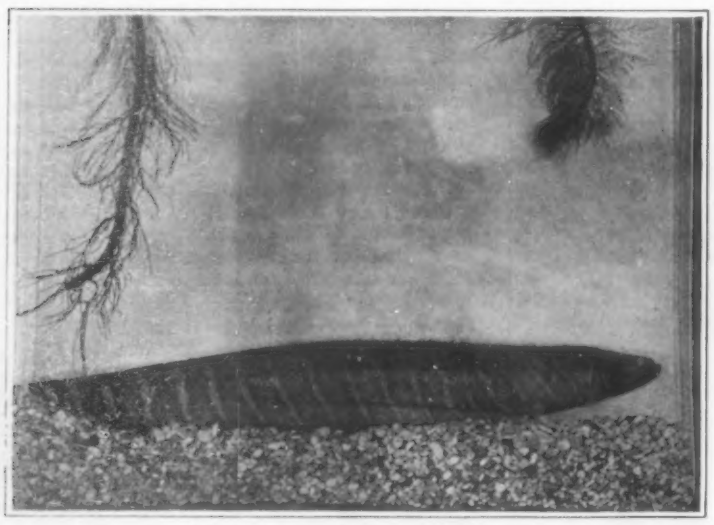
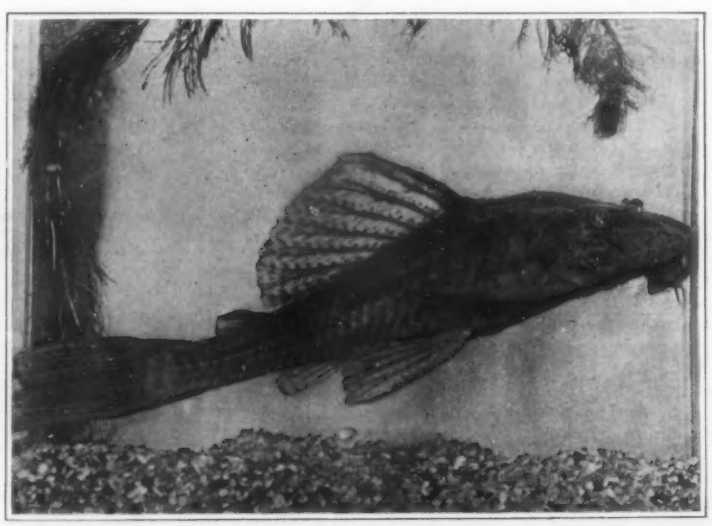


A South American eel (*Sternophygus*).



Armored catfish (*Plecostomus Commersoni*).

Dead Matter That Seems Alive

Synthetic Ideas About Life

By Benjamin C. Gruenberg

THERE is an old story about some blind men who reported upon the nature of the elephant, after making a thorough investigation, to the effect that this animal is like a tree trunk, like a rope, and like a fan. This story was no doubt invented by some ancient oriental sage to show the fallacy of generalizations based on fragmentary and unrelated experiences. When Dr. Stéphane Leduc, some twelve or thirteen years ago, began his experiments with diffusion, he did not claim to have discovered the physical basis of life; he was content to point out merely the curious similarity between the diffusion processes in gelatin and the diffusion processes in living beings. Well trained in the methods of modern science, he did not confuse the rope-like structure and the elephant: he said simply that the rope is like—not an elephant, but like a certain part of an elephant. But as his familiarity with osmosis and diffusion increased, he discovered more and more points of resemblance between these phenomena on the one hand and what happens in living organisms on the other. And gradually he has acquired the habit of thinking and speaking as though the elephant consisted essentially of a rope, a couple of fans and three or four tree trunks. This is, as it were, a synthetic conception of an elephant.

In his introduction to the second volume in his series of studies in biophysics—"La Bioligie Snythétique"*—Prof. Leduc says that his work is an interpretation (of life) based upon experimental facts. The book itself is given over almost entirely to a description of facts, and to a comparison of certain classes of facts. There is very little in the way of interpretation. The first chapter is an excellent one on mechanism versus mysticism, in which we are reminded that scientific progress is made possible by escaping from magic words and formulæ into the path of trial and measurement. Of course the author rejects all forms of vitalism, and seeks to assimilate life processes to more familiar physical and chemical processes. Then he develops the idea of dynamic centers, starting with Faraday's fields of force. Throughout the book there are excellent reproductions from photographs illustrating structures and movements obtained experimentally by diffusion in inorganic solutions, in comparison with electrical and magnetic phenomena on the one hand, and with cellular phenomena on the other. The idea of dynamic centers in living beings is illustrated by such facts as the radiations from the centrosome of a cell about to divide, the concentric layers in a grain of starch, the successive layers of wood in a tree trunk, or the layers deposited in a mollusc shell. Similar structures—that is, radiations and laminations—can be obtained by purely inorganic processes. For example, if a drop of India ink is placed in a salt solution, the diffusion will proceed in all directions (Fig. 1), and the appearance resulting will resemble that of an electrical field on the one hand (Fig. 2), and the radiations about a nucleus often seen in a living cell. If two drops of ink are placed in the salt solution, near each other, the diffusion currents between the two drops will take on the appearance of a magnetic field between two poles, or that of a "spindle" formed during the division of a cell nucleus (Fig. 6).

In a 10 per cent solution of gelatin containing a trace of calcium chloride or nitrate, a mixture of equal parts of saturated solutions of sodium carbonate and disodium phosphate is placed. The diffusion proceeds in waves, along such delicate lines, that iridescence may be observed. Fig. 7 shows the concentric waves, giving the appearance of a grain of starch. The iridescent striations suggest similar phenomena in the feathers of the peacock, in the elytra of beetles, in mother of

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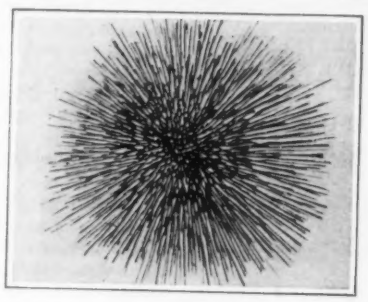


Fig. 1.—Diffusion of India ink in salt water.

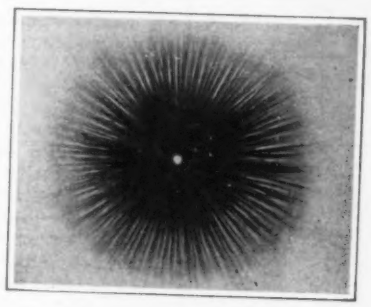


Fig. 2.—An electrical field of force

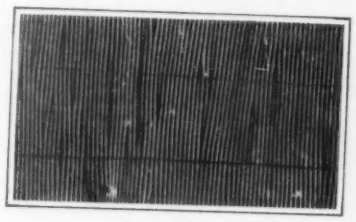


Fig. 3.—Striated diffusion lines × 500.

Fig. 4.—"Artificial" nerve cell.

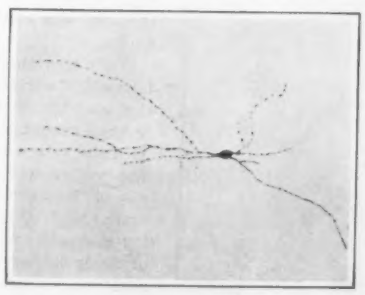


Fig. 5.—Ganglion nerve cell, by Demoor after the method of Golgi.

Fig. 6.—Diffusion of currents between two poles of different concentration.

Fig. 7.—Striated structure resembling a grain of starch.

Fig. 8.—An electric discharge which resembles a leaf.

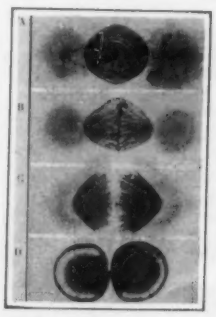


Fig. 9.—Four successive stages in "karyokinetic" figures produced by diffusion.

Fig. 10.—Electrolytic figure suggesting a fern frond.

Fig. 11.—Crystallization figure; ammonium chloride in gelatin.

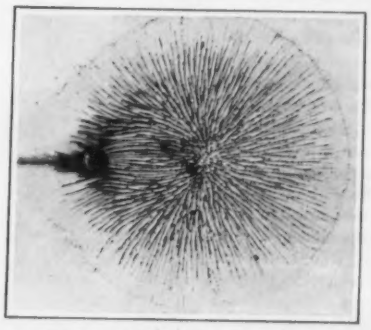


Fig. 12.—Modification of diffusion currents by contact of a glass rod, illustrating irritability.

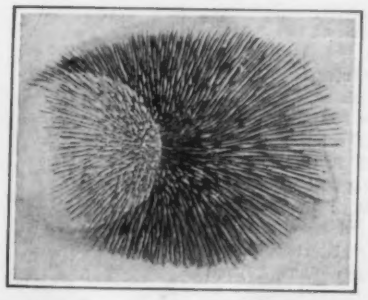


Fig. 13.—"Negative heliotropism" of diffusion currents of India ink in salt solution.

* 1912. A. Poinat, publisher, 121 Boulevard St. Michel, Paris.

The Airman and the Weather

Aeronautic Meteorology: A New Branch of Applied Science

By Charles Fitzhugh Talman

AERONAUTICAL meteorology is to the aeronaut what maritime meteorology and hydrography, together, are to the mariner. That it is destined to play an all-important part in the navigation of the air is so obvious as to require no demonstration. Taking this for granted, there are, however, certain questions to be answered in order to fix the status of this branch of knowledge in the aeronautical curriculum. How much, actually, do we know about the laws of the atmosphere bearing on aeronautics? Has the science reached a practical stage, or is it still so tentative and uncertain that, for the present, the individual aeronaut should look upon his personal experience as a safer guide than the generalized knowledge now available? Is the meteorologist still, as formerly, learning more about the free atmosphere from the aeronaut than the latter is learning from the meteorologist?

If for any reason the world became interested in blowing soap bubbles we should not have long to wait for an exhaustive "Lehrbuch der Seifenblasenkunde" from Germany. It was in the normal order of events that a German gave us the first text book of aeronautical meteorology[1], and that we are promised from the same pen a companion work on aeronautical climatology; but it is safe to say that few meteorologists were prepared to find in Dr. Linke's pioneer work a complete new branch of applied science, embodying a wealth of information not only useful, but indispensable, to every person who risks life and limb in navigating the air. This book fully answers the questions we raised a moment ago. Aeronautical meteorology has arrived.

The present writer has reviewed Linke's book in the SCIENTIFIC AMERICAN (June 24th, 1911, p. 630, and April 20th, 1912, p. 368), and it is not necessary to repeat here what has already been said about its many merits. The young German author, though himself a practical aeronaut as well as a meteorologist, is of course primarily a mere spokesman for the scientific aeronauts of his country, and his work reflects credit upon many besides himself. Our purpose now is simply to cite a few facts from the work in question, and from other recent literature, serving to show to what extent meteorology is already prepared to take up the new tasks imposed upon it by the sudden efflorescence of the art of aeronautics.

It was a providential circumstance that meteorologists had made a substantial beginning in the systematic study of the upper air a few years before the invention of the first practical aeroplanes and dirigible balloons. The new science of aerology—i. e., the survey of the atmosphere throughout its vertical extent, by all possible methods—dating, as a coherent body of knowledge, from about the beginning of the present century, pushes its investigations some three hundred miles above the earth. The balloonist, in extreme cases, rises 6½ miles; the aviator, 2½ miles. Thus it happens that much of the matter of aerology has no direct bearing on aeronautics. Even the remarkable isothermal layer, or stratosphere, the discovery of which, in the year 1902, marked an epoch in the history of science, lies at such an altitude that it is doubtful whether any human being will ever travel up to its lower boundary; though it is now almost daily entered by unmanned balloons carrying self-registering instruments. As to the lofty regions, beyond the reach of the sounding-balloon, in which the atmosphere is no longer "air," but hydrogen, or helium, or "geocoronium," or what-not, these are of no more practical concern to the aerial navigator than to the prosaic wayfarer on *terra firma*.

[1] F. Linke, *Aeronautische Meteorologie*, 2 vols., Frankfurt a. M., 1911.

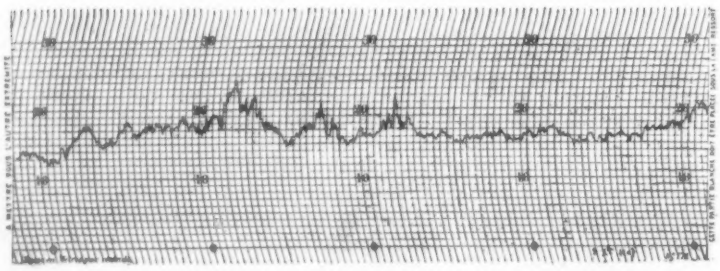
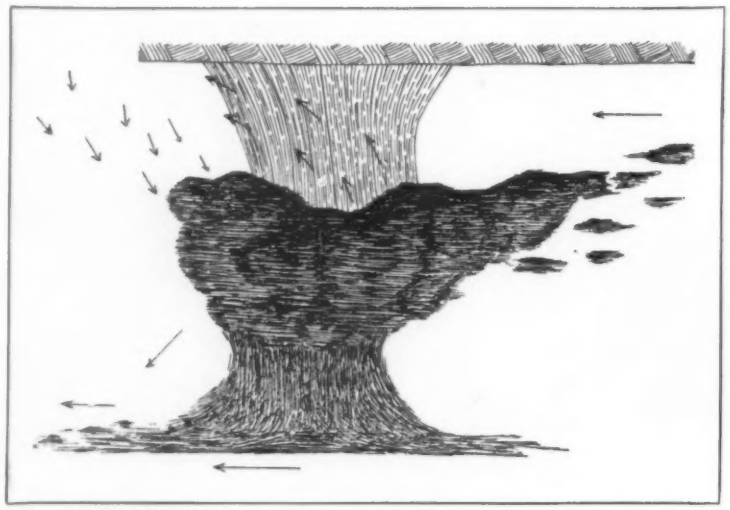
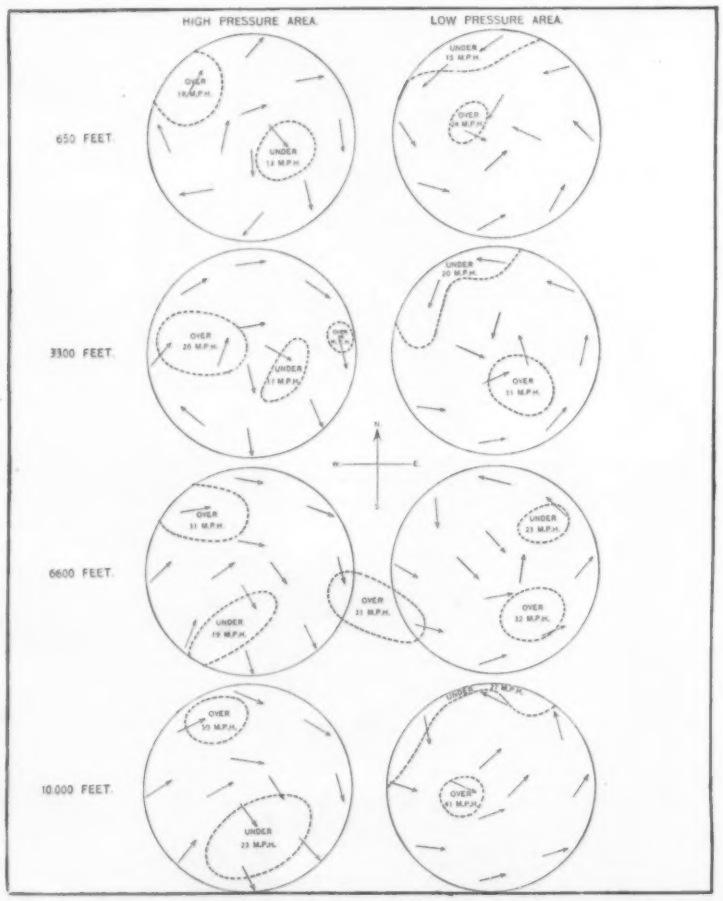


Fig. 1.—Gustiness of the wind. Shown by the record of a Richard anemocinemograph. The speed of the wind at each moment is here registered in meters per second.



From Linke's *Aeronautische Meteorologie*.

Fig. 2.—"It is notorious that the greatest enemy of all kinds of air-navigation is the thunderstorm; . . . not only because of its electrical dangers, but because of the strong vertical air movements by which it is attended."—Linke.



From Rotch and Palmer's *Charts of the Atmosphere* (New York, 1911: John Wiley & Sons).

Fig. 3.—Variations of the force and the direction of winds at different altitudes in high and low-pressure areas.

However, in order to reach the stratosphere every sounding-balloon must pass through the troposphere, and all ascents of meteorological kites are confined within this lower stratum. Thus the great bulk of the data acquired by the aerologist pertains to regions accessible to the aeronaut.

Before all things else the aeronaut is interested in the wind. The combined labors of the aerologist and the aeronautical engineer have completely upset old-fashioned ideas concerning this element. No longer do we think of a wind as a steady horizontal stream of air, in which every particle is moving at the same speed as every other particle. Such a wind would be a boon to the aeronaut if it existed, but it does not—as was first conclusively proved by Langley, and as is shown in the record of every aerological observation. In the first place, a wind is rarely horizontal, but has, instead, a more or less pronounced vertical component, of which the ordinary wind-vane and anemometer give not the slightest token. In the second place, no wind is absolutely steady or homogeneous; and most winds are quite the reverse. When two anemometers are placed side by side, a few feet apart, one of them may, for a brief period, indicate a velocity twice as great as the other. Moreover, a single anemometer, if sufficiently delicate, will show incessant fluctuations in the strength of the wind. This "gustiness" is not well brought out in the records of the ordinary registering anemometer, but it is strikingly shown in those of the Dines pressure-tube anemometer, or the Richard anemocinemograph (Fig. 1), or the apparatus attached to the winch of a meteorological kite for recording the tension on the kite-wire.

That the wind commonly has a vertical component, that gustiness is the rule rather than the exception, and that great variations in velocity occur from one place to another, are facts that the aeronaut would soon find out for himself. It is the business of the meteorologist to tell him under what conditions he may expect these features to be most pronounced or most persistent, and what limiting magnitudes they may assume.

For example, the meteorologist teaches the aeronaut to distinguish the typical forms of clouds, for the very practical purpose of enabling him to recognize those forms which are characteristic of vertical air movements, and those which denote mainly horizontal movements. A cumulus cloud is proof positive of the existence of a strong ascending current beneath it; while in the intervals between neighboring cumuli the air is likely to be sinking. Prof. Humphreys has happily described these vertical movements as "aerial fountains" and "aerial cataracts," and has shown that they are among the numerous causes of the so-called "hole in the air."

What maximum speed may be attained by vertical air currents? This is a question that the aeronaut would hardly care to have answered by a personal encounter with the extreme case of the phenomenon. The meteorologist, with the statistics of almost innumerable observations at his command, is able to tell him that ascending currents sometimes move at the rate of 25 or 30 feet a second, and that these rapid movements in the vertical occur especially in connection with thunder-squalls. Furthermore, the meteorologist

(*Concluded on page 101.*)

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

An Electrically Controlled Two-speed Rear Axle Design for Motor Cars

WITH the constantly increasing cost of gasoline, automobile manufacturers have been hard put to it to discover means either to decrease the voraciousness of their motors or in some way to increase the number of miles their cars will run on the fuel contained in their tanks. One way out of the difficulty is to increase the final drive gear ratio between the engine and the road wheels, though when this increase is made permanent there arises the difficulty of obtaining flexibility at low speeds and with none of the transmission gears in use—on "top gear," in other words.

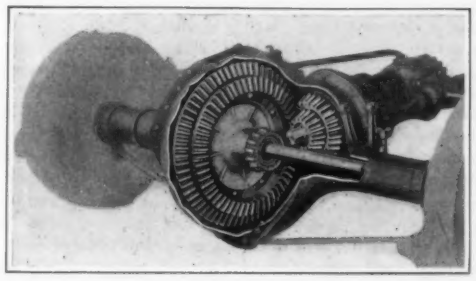
Now, however, there has been developed by a prominent Detroit automobile manufacturer a novel type of electrically controlled two-speed, or two-gear, rear axle that bids fair to solve the eternal fuel problem in addition to having several other advantages of importance. The idea of the two-gear rear axle is not new, of course, for as long ago as 1907 the Italian Fiat Company filed application for patents on a device of the kind; and since then two other foreign and at least one other American manufacturer have taken it up. The first American device appeared in Chicago at the automobile show early this year.

The method of controlling the gear changes in the new axle that has just been brought out, however, is brand new; nothing like it has ever been attempted before. Prior to the appearance of this axle, gear changes in other axles of the kind have been made manually by means of a lever similar to the ordinary transmission gear-set lever. In this new axle, which is illustrated herewith, the gear changes are made with the aid of magnets controlled by a small button placed conveniently at the driver's hand. Hence, to obtain either high or low gear requires merely the depression of the button, no other movement being required.

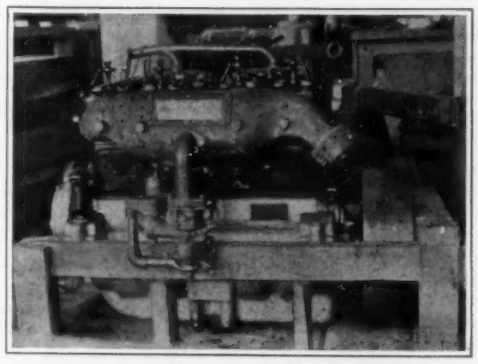
In construction, the new axle is much like the orthodox pattern of rear axle except that it has two bevel rings and two bevel pinions instead of one of each. One of the bevel pinions is connected to a solid shaft which is carried on bearings inside a hollow shaft to which the other bevel pinion is attached; the gears are constantly in mesh and the magnets operate clutches.

Just how much the new axle may be expected to decrease fuel consumption may be gathered from the fact that the use of the high gear ratio increases the car speed just 42 per cent with the engine revolutions remaining constant. For instance, with the engine turning at 700 revolutions a minute and the low gear in use the speed of the car will be approximately 21 miles an hour, whereas with the high gear in use the car speed will be approximately 30 miles an hour. In other words, the car will travel nine miles farther on a given amount of fuel with high gear in use than it will with the low gear in use. The high gear gives a final ratio of 2.5 to 1 and the low gear a ratio of 3.66 to 1.

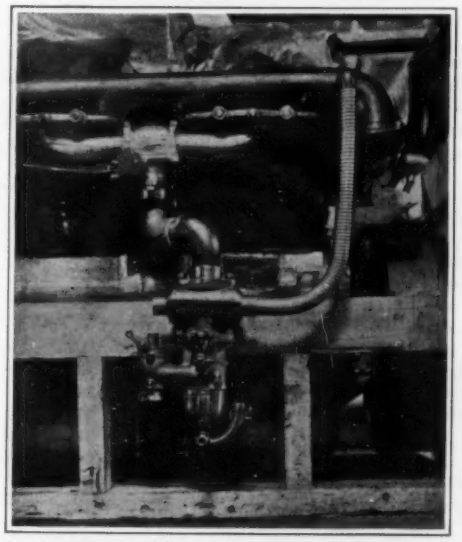
The increase in mileage, of course, is supplemental to decreased wear and tear in the parts, due to the slower speed at which they operate when the high gear is in use. Also, engine vibration, which always constitutes a menace to the life parts, is matrially reduced at high car speeds. The new axle is being used as standard equipment on all of the cars produced by the manufacturer for the 1914 season.



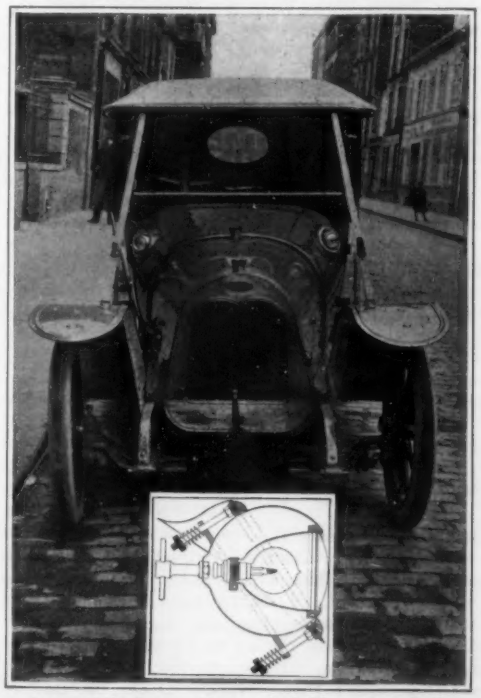
A two-speed direct drive axle for automobiles.



Gasifier inclosing part of the exhaust.



Gasifier connected by flexible tube with the exhaust.



Automobile lamps that swivel like an eyeball.

A Test of Milking Machines

THERE recently took place in England a competitive test of milking machines under the auspices of the Royal Agricultural Society. Thirteen machines were entered. The winning machine, manufactured by a Swedish company, is built on the vacuum or suction principle. The milk is conducted by transparent celluloid tubes to the containing vessel which is hung under the cow by means of a girth, and the milking is performed in much the same way as with other vacuum machines. While a vacuum or suction principle machine won the test, it is reported that all but five suction principle machines were ruled out after the first trial, and that after the second three more were eliminated, the remaining two taking first and second prizes.

The First First Assistant Commissioner

C. C. BILLINGS, who has the distinction of being the first First Assistant Commissioner of Patents, having been appointed to such position on May 8th, 1909, by President Taft on the creation of the office, has resigned the position to take effect August 31st, 1913. Mr. Billings' service as First Assistant Commissioner follows that of Assistant Commissioner, to which position he was appointed June 1st, 1907, by President Roosevelt, and a term of service in the Patent Office extending continuously from his appointment as Fourth Assistant Examiner under Civil Service on May 24th, 1899, with the exception of a short period when he accepted a commission as ensign in the Navy for service in the Spanish war. Mr. Billings has been a most courteous and efficient officer and resigns the service to enter upon the practice of patent law in New York city.

Distillate Gasifiers for Motor Vehicles

THE cost of fuel for motor trucks is cut to less than half by the use of gasifiers, extensively employed on commercial vehicles in California. The gasifiers are placed on the engine in such a way as to heat the carbureter mixture just before it is delivered to the cylinders, and in this way it is possible to secure excellent results with distillate. The gas is delivered dry and hot and ready for combustion with the same regularity as gasoline, and carbonization, caused by imperfect combustion, is practically eliminated. The cost of gasoline in Los Angeles is 17 cents a gallon, while distillate sells at only 7 cents a gallon and delivers 25 per cent more power. This effects an enormous saving to owners of motor trucks in the course of a year. Owing to the odor of distillate, it is not used on pleasure vehicles.

Two types of gasifiers are in common use in California, both based upon the same principle. One consists of a large casting bolted to the engine, inclosing part of the exhaust. The casting is perforated so that the air which enters the carbureter passes over heated metal before being combined with the distillate, and the mixture from the carbureter passes through the hot cylinder on its way to the cylinders, being delivered at a temperature of 160 degrees. The other consists of a cylindrical brass casting filled with tubes like a boiler. This is attached between the carbureter and the cylinders and connected with the exhaust through a length of flexible tubing. The air is not heated before entering the carbureter as in the other type, but the mixture passes over the heated tubing before reaching the cylinders. In using both types, an auxiliary tank of gasoline is carried for starting the engines, though it is not required for starting, while the gasifier and engine are warm.

A Portable Controller for Electric Cranes

IT is reported from abroad, that a new method of controlling cranes has recently been introduced on the docks of the Manchester ship canal and at other points in England, in which the crane controller instead of being operated from the cab of the crane as heretofore, is portable, weighing but six or eight pounds, so that it can be suspended from the shoulders of the operator, who can then occupy an advantageous position with regard to the work, move about and see what is taking place in the hold of the vessel. In the past he has had to depend on signals given by a man standing at the hatchway. The controller is provided with a push switch. To stop in an emergency, it is necessary for the operator only to hit the knob of the push switch to bring the crane motor to a stop. The invention not only facilitates the operation of the crane, but effects a material economy by dispensing with the necessity of the signalman employed at the hatchway.

Strange Headlights from France

A NEW automobile headlight has just been put on the market in France, which represents a radical departure from present designs. As will be seen from the accompanying illustrations, the lamp has the shape of a human eyeball and turns in its socket in exactly the same manner as the eye in its support. Two small clamps, controlled by thumbscrews from the interior of the car, hold the lamp in position in any desired direction, while the handle itself is used in turning the light rays to the spot they are needed. Signposts at the side of the road or the low-lying milestones are thus brought within reach of the rays, while in their lowest position they even throw light into the hood, lighting up the motor, magneto and carbureter. By removing the two small clamps entirely, the whole lamp can be taken out of the socket and used as a "trouble lamp" inside or outside the machine. It is the invention of a French engineer, Edouard Cannevel.

Notes for Inventors

A Wave Motor for Propelling Boats.—Patent No. 1,066,896, to John Frame of Searsport, Maine, shows a boat equipped with a motor so constructed as to drive the propeller shaft of the boat upon the rise and fall of the boat by the action of the waves.

Four Signature Writing Machine Patents.—A series of four patents, Nos. 1,066,115 to 1,066,118, inclusive, has been issued to Frank Amos Johnson of Jersey City, assignor to Signature Company of New York city for machines for writing a number of signatures and duplicates, at the same time.

A Glider Instead of a Roller-skate.—A patent has been issued to John H. Koenig of New York city, No. 1,067,039, for a glider which is in the nature of a skate, having relatively flexible portions for the heel and toe and provided on the under sides thereof with curved gliding surfaces somewhat similar to the "domes of silence" employed on furniture.

A Tubular Corrugated Railroad Tie.—Ernest J. Pettegrew of Wayside, Neb., has secured a patent, No. 1,066,943, for a metallic railway tie which is in the form of a tube continuous throughout and has corrugations extending entirely around it between the rails and also outside of the rails with the intermediate spaces for receiving the rails free of corrugations.

A Brake Shoe Patent.—In patent No. 1,066,119 to Harry Jones, of Suffern, N. Y., assignor to American Brake Shoe and Foundry Company of Mahwah, N. J., is shown a flanged brake shoe in which a metallic body portion contacts with the tread of a car wheel while a flanged portion of non-metallic material is provided to contact with the flange of the wheel.

A Novel Method of Producing Ozonized Air.—A patent, No. 1,066,065, has been issued to James Todd of Sewickley, Penn., for a method of producing so-called ozonized air. The amount of air passing to the ozonizer is varied according to the temperature of the surrounding atmosphere, and is reduced as the temperature rises and increased as the temperature falls.

Advertising Device to Create Illusions.—George H. Schanck of Libertyville, Ill., has secured patent No. 1,066,850, for an advertising device which simulates perpetual motion and employs a revolving wheel, suitably driven, and having arms which are pivoted to swing and upon which balls roll back and forth in such manner as to increase the effect of the device being a perpetual motion machine.

A Combined Bottle Stopper and Puller.—George J. Dysinger and Johnnie C. Haskell of Galena, Ore., in a patent, No. 1,060,172, present a staple embedded in a bottle stopper and a separate part formed from a single length of wire and bent to provide a finger hold for use in pulling the bottle, the puller being connected with the stopper staple and such puller also having arms formed to engage with the shoulder on the bottle neck to hold the stopper in the bottle.

French Kitchens.—It is reported that a leading merchant of Havre recently made in his store windows a display of his idea of a thoroughly equipped kitchen for a family in comfortable circumstances. While it has been conceded from time immemorial that the French nation leads the world in culinary skill and economy, it is a tribute to the ingenuity of Americans that six articles of American manufacture were included in the equipment of the ideal kitchen displayed by this French merchant. These six articles included an ice-cream freezer, an ice pick, a hashing machine, a cake-baking mold, a coffee pot and a broom.

A Gyroscopic Dumbbell.—A gyroscopic dumbbell has been patented, No. 1,058,786, to Burt L. Newkirk and Otto S. Zelner of Minneapolis. The device includes a dumbbell with a shaft journaled in it and gyroscopic disks on the shaft providing an exercising device which is free from attachment to any apparatus and when held in the hand is capable of offering resistance to motions made by the user whenever such motions would tend to change the direction of the axle or axles of the rotating masses.

Planting Artificial Hair in the Scalp.—Aurel Popovics of Torok-Kanizsa, Austria, has patented, No. 1,059,631, a method of imbedding artificial hair in the scalp. A retaining element is applied to the hair and a minute cavity is pierced in the scalp. The end and the retaining element of the hair is inserted in the cavity below the surface of the skin, so that hairs can be planted in the skin with, the inventor claims, such a degree of perfection as to render the artificial nature of the hair covering thus produced completely unnoticeable.

An Improved Brick Tie.—Consul Van Sant of Dunfermline, Scotland, reports that a builder in Dunfermline has recently invented a new type of wall tie and that while the tie formerly used gripped but two bricks, the improved tie will catch a half dozen bricks giving additional strength to the wall, requiring fewer ties and resulting in a considerable saving in the bricks used in large operations. The tie can also be seen before the wall is plastered and thus avoids any dispute about using fewer bricks than the number specified by the architect.

Another Hulett Conveyor Patent.—George H. Hulett of Cleveland, Ohio, assignor to the Wellman-Seaver-Morgan Company of the same place has patented a system for unloading cars into vessels. This includes appliances for tilting the car and dumping its contents. A motor-driven, automatic-dumping car receives the load from the first car and an elevator lifts the automatic dumping car to an elevated trestle which has a chute into which the contents of the dumping car are discharged. The dumping car is returned to its starting point by a suitable downwardly inclined track. The patent is No. 1,066,015.

Egg Packages.—Think of a gross of million broken eggs. Such is the yearly crop of broken eggs marketed in New York city alone. Of course, this includes the breakage in packing, the breakage in transit and the breakage in unpacking. It is probable that the breakage in packing and unpacking equals that in transit. It is reported that the Department of Agriculture is investigating the subject. The problem presented is an interesting one to inventors. The package of course, must not be too expensive and the packing and unpacking operations must be capable of accomplishment with facility as well as safety.

Patent and Trade-mark Registration in the Philippines.—Under an act passed at the last session of the Philippine Legislature any patent or trade-mark registered in the United States Patent Office, upon being filed in the executive bureau of the Philippines and the fee for such purpose paid, shall receive the same protection as is accorded in the United States, and persons infringing such patent or trade-mark shall be liable to the same penalties. It is provided that the rights of property in patents and trade-marks secured in the Islands under the Spanish Laws shall be respected as if such laws were in full force and effect.

A Sanitary Milk Bottle.—Realizing some objections from a sanitary point of view to the ordinary milk bottle, Merritt G. Seamans of Atlanta, Ga., has patented a lining for milk bottles which may be of paper or other suitable material and can be slipped down into the bottle and will be expanded by the force of the liquid inserted therein and has a portion which is bent over and down along the outer side of the lip of the bottle. A closing disk may be inserted as usual.

Talking Moving Pictures.—Henry Theodore Crapo, of New York city, assignor to George Regester Webb of Baltimore, Maryland, has secured patent, No. 1,026,324, in which motion picture and sound-reproducing devices are geared to run at relatively different speeds and a driver is provided in connection with a governor-coupling which is controlled by the driver and connects the motion picture and sound-reproducing devices with the drive member so as to produce unison of action between the picture device and the sound reproducer without change in the relative speeds under fluctuations of speed derived from the drive member.

A Toggle Spoke Spring Wheel.—In patent No. 1,065,386, to Frank J. Nicolet of Stockdale, Ohio, is shown a spring wheel in which sectional spokes composed of two sections pivoted together at one end and pivoted respectively at their other ends to the rim and hub are arranged to connect the hub and rim. Springs are disposed to act on the outer sections in such manner as to permit the wheel to yield under pressure and at the same time tend normally to hold the hub at the center of the rim.

Synchronizing Motion and Sound Reproduction.—Edward H. Amet of Redondo Beach, Cal., has secured a patent, No. 1,065,576, in which is shown a motion-picture machine with a film provided with perforations on lines between the pictures spaces and means are provided to supply pneumatic pressure on the picture ribbon. This pneumatic pressure operates through the perforations in the picture film to actuate electro-pneumatic means which control the operation of the sound reproducing machine, thus securing a sychronous operation.

Advertising Novelty.—Dorsie A. Lohr of Woodlawn, Pa., has patented, No. 1,061,302, as an advertising novelty, a megaphone which is adapted to be collapsed into the form of a fan and to be held in such form so that it can be used as a fan, the megaphone having a telescopic mouthpiece which may be adjusted to serve as the handle of the fan.

New Needle for Talking Machine.—In patent No. 1,061,408, to Percy B. Ruggles, of Wyoming, O., is shown a reproducing needle for talking machines which is made from the shaft of a feather with the barbs removed, such shaft possessing an outer shell with a softer interior, the structure being artificially hardened to render it more desirable.

A Trick-playing Card.—A playing card which can be made to show clubs or spades at the will of the holder is illustrated in a patent, No. 1,061,576, to George W. Walter, of New York city, assignor to Edgar G. Walthall of same place. The card comprises a face card having clubs marked thereon and openings adjacent to the clubs and forming with the clubs the outline of spades and a sliding card which has portions the same shade as the clubs and other portions the same shade as the ground of the face card and the sliding card can be moved to place either of said portions in register with the openings in the face card.

A Removable Dental Bridge.—Harry A. Gollobin and Newton A. Bornstein of Newark, N. J., assignors to The Dental Denture Improvement Company, of the same place, have patented, No. 1,062,233, a removable bridge for teeth in which the bridge has a flat split tongue or resilient material, the branches of which engage within a recess in a crown portion of a tooth, so that the bridge will be securely held in use and yet can be removed when necessary.

A Steinmetz Incandescent Lamp.—The well-known inventor, Charles P. Steinmetz, assignor to General Electric Company, has patented an incandescent lamp patent, No. 1,062,305, in which an incandescent conductor is disposed within an evacuated envelope and supplied with current and means provided for furnishing gas-absorbing material during the operation of the lamp by the disintegrating action of an electrical discharge taking place across a portion of the evacuated space.

Nickel-in-Slot Telephone System.—The Automatic Electric Company, of Chicago, as assignee of John Erickson, also of Chicago, has secured a patent, No. 1,062,387, for a telephone system in which means are provided for establishing a talking circuit between any two lines of the subscribers and a coin-collecting device upon one of said lines is arranged in connection with means for rendering the talking circuit inoperative and means are also provided, controlled by depositing a plurality of coins in the coin-collecting device, for rendering the talking circuit operative.

A Combined Smokestack and a Life-preserver.—A life-saving device is shown in a patent, No. 1,061,209, to William Monroe White of Milwaukee, Wis., in the form of a ship stack which is detachable and is formed with an air-tight compartment. As shown, the stack is flattened transversely and has an air-tight compartment at each of its two more flexed sides, and the stack when detached and in the water may operate as a life-preserver or life-raft, its capacity varying with its size.

A Cover that Operates a Valve.—In patent No. 1,062,209, to John L. Williams, Jr., of Jackson City, Tennessee, for a sanitary drinking fountain, a hinged cover is arranged to close the drinking cup and this cover operates when opened to open the supply valve, such valve being closed automatically by a spring when the cover is closed so that the water only flows when the cover is raised by some one desiring a drink.

Legal Notes

Patentability of Process as Related to Apparatus.—The Court of Appeals of the District of Columbia in re Rowe has sustained the decision of the Commissioner of Patents in rejecting the application and held that the claims were properly refused on the ground that they are merely statements in different words of the invention covered by applicant's prior apparatus, the Court saying: "An invention is not made different by the mere fact that one is disclosed in a claim for an apparatus patent and the other one in the form of a method or process."

Employer and Employee.—The case of Jameson and Yesbera v. Ellsworth, decided by the Court of Appeals of the District of Columbia, brought up an interesting point. The appellant Yesbera was the president of the Yesbera Manufacturing Company, while Jameson was a foreman of the company, and the appellee Ellsworth general manager of the company at the time of the conception and reduction to practice of the invention. The Court stated that as between Yesbera and the appellee Ellsworth the presumption of inventorship was in favor of the employer, but that before such rule might be invoked, it must appear that the employee was engaged in perfecting a device under the general direction of the employer; that appellee was not employed for the purpose of perfecting this or any other invention and that hence it must be affirmatively shown that at least the broad idea was disclosed to Ellsworth by Yesbera before the presumption referred to would attach.

The Commissioner's Right to Review.—The Court of Appeals of the District of Columbia in the case of Moore, Commissioner of Patents, et al. v. United States ex rel. Chott. has confirmed the Commissioner's right of review after favorable decision by a subordinate tribunal. The case arose in a peculiar way, the Board of Examiners-in-Chief on appeal reversing the decision of the Primary Examiner and deciding the claims to be patentable, whereupon the Primary Examiner acting by authority of the Commissioner, made an additional investigation, cited additional patents and the Commissioner took up the case and approved the action of the Primary Examiner. The applicant sought the aid of a mandamus writ in the Supreme Court of the District of Columbia and Mr. Justice Barnard of such Court granted the writ to compel the issue of a patent to the applicant. On appeal the Court of Appeals has held that the Commissioner has authority to review the application and if in his opinion the alleged invention is not patentable to refuse a patent therefor; also that mandamus cannot be substituted for the remedy offered by appeal.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

EMBROIDERED APPAREL.—W. FREED, 152 Fifth Ave., Manhattan, N. Y., N. Y. This invention attains its object of constructing a one-piece garment of different pieces suitably seamed together, the seams taking the form of an embroidered design, and embroidering the article so that portions of the embroidery will hide the seams.

SHOE CLEANER.—W. J. LLOYD, Manhattan, N. Y., N. Y. The purpose here is to provide a cleaner having brush members with guides for traveling in curved slots, so that the members will be moved as desired relatively to a shoe, when the members are pressed by a shoe away from each other and against the tension of resilient means.

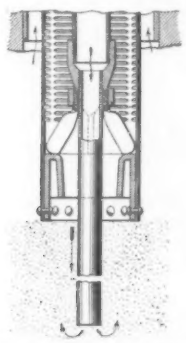
Of Interest to Farmers.

BEET CROWNER.—J. B. DAWSON, P. O. Box 57, Pompeys Pillar, Mont. This inventor provides a device capable of being attached to existing lifting machines, wherein means provide for crowning the individual beets while yet held in position in the ground, at a predetermined depth, and wherein means provide for insuring the crowning of each beet at an equal distance from its top, and whereby means permit the device to be moved into or out of operative position.

ORCHARD STEP LADDER.—C. HEWETT, Box 262, R. F. D. No. 2, Wenatchee, Wash. An object of the inventor is to provide a step ladder in which strength, lightness and rigidity combine to make the ladder especially convenient for use in orchards, and in work generally among trees and shrubs.

Of General Interest.

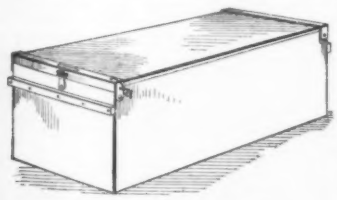
DEVICE FOR SINKING STRAINERS.—C. L. HOUSTON, room 312, Astoria Savings Bank Bldg., Astoria, Ore. This invention relates to means used for sinking a strainer in a well, and has reference more particularly to a de-



DEVICE FOR SINKING STRAINERS.

vice of the class comprising a tubular member through which water is forced and which projects through the bottom of this strainer, and means on the tubular member and in said strainer whereby the weight of all the tubes extending to the top of the well is added to the strainer to help the sinking of the strainer rapidly in the well.

BOX COVER FASTENING.—C. T. JENEWEIN, Blackhawk, and CHARLES W. DOBELIN, 219 East Main Street, Madison, Wis. Address the latter, same place. The invention is an improvement in the class of de-



BOX COVER FASTENING.

vices for securing lids or covers of boxes without aid of nails or screws, a metal keeper being hinged to one end of the box body and provided with means for securing it in closed position after the cover has been put in place.

FLOOD GATE.—C. B. JONES, Nezpique, La. The invention has particular reference to a means for securing a constant and regular delivery or flow of water from a reservoir or source of supply, the depth of which is variable. More particularly it consists of a means for delivering definite or regular quantities from a main canal for use by parties tributary to such canal for irrigation purposes.

CHANGEABLE LETTER SIGN.—C. M. KINNEY, care of M. Kinney & Co., 3 W. 29th St., New York, N. Y. This inventor provides a means whereby the names or words which make up a bulletin board or directory for an office building or the like may be more readily changed or shifted than is possible with the means now in common use.

DEEP WELL PUMP.—W. S. CUNNINGHAM, 455 Cherry St., Springfield, Mo. The object here is to provide a pump of reciprocating, double-acting type, which will give a continuous flow of liquid and require minimum attention, having few moving parts, and all the

DEEP WELL PUMP.

parts of the pump being so positioned as to form an easily extractable unit readily accessible for inspection and repairs. This is carried out by a pump comprising two concentric cylinders forming the predetermined voluminal clearance, a hollow reciprocating piston in the inner of said cylinders, and automatically operated inlets and outlets associated with said cylinders and piston.

MUSIC STAND.—J. HRABAK, Kermit, N. D. The object here is to provide a stand which may be conveniently and readily folded into a compact structure of substantially reduced size, whereby to render its transportation more ready and convenient.

COMBINED TOWEL HOLDER AND LOCK.—G. REID, Osage City, Kan. For the purpose of holding and securing towels in toilet and other rooms in such manner as to prevent removal without interfering with their convenient use, the invention provides the towels with eyelets and strings them on a bar or rod which

COMBINED TOWEL HOLDER AND LOCK.

is supported in and locked to a fixed support, and to whose outer end a chain is attached, the other end of the latter being secured to a wall staple or ring. The towels are normally held on the bar or rod, but may be slid off and down on the pendent chain so as to be conveniently used, the soiled towel hanging on the loose portion of the chain.

BRIDGE.—H. E. MATTESON, Maud, Okla. Address Charles W. Friend, P. O. Box 23, Irving, Ky. The purpose of this improvement is to provide a novel form of bridge in which the device is self-bracing, i. e., as the load upon the bridge is increased the bracing effect of the brace rods is increased so that there is no danger of the bridge collapsing through undue strain.

AUTOMATIC WATER STERILIZER.—L. VIGER, 71 Central Park West, New York, N. Y. This invention relates to apparatus for treating liquids, especially water for drinking or cooking purposes, and particularly refers to a means whereby water may be sterilized or purified without detracting from its natural properties with respect to its proper pleasant taste.

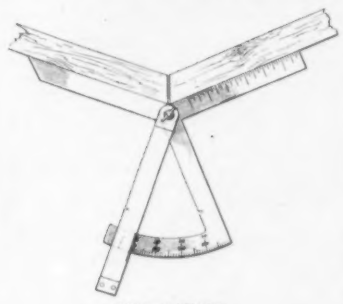
APPARATUS FOR PRODUCING ETHER.—D. ANNARATONE, Settimo Torinese, near Turin, Italy. The invention relates to an apparatus for producing ether, the purpose being to render the apparatus highly productive, and comparatively cheap in operation, especially as regards the quantity of fuel and manual labor required.

Hardware and Tools.

CRIMPING TOOL.—J. WOOD, 143 Seventh St., Long Island City, N. Y., N. Y. This tool is more especially designed for crimping a metallic cap onto the flaring mouth of the spout of an oil can or other receptacle, and arranged to enable the operator to quickly and effectively crimp the cap in position without requiring much physical labor.

TOOL FOR SETTING JEWELS.—L. A. FITZPATRICK, Klamath Falls, Ore. The purpose here is to provide for the automatic adjustment of the point or cutting edge of the tool in direct accordance with the size of the jewel to be set in watch plates, settings and the like, so that the tool will automatically cut or turn out the seat of exactly the proper size.

ROOF SQUARE.—P. N. BERGGREN, San Jose, Cal. The object of this invention is to provide a square especially fitted for roof work, but equally well adapted for any work wherein



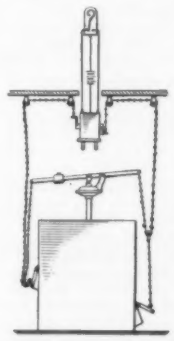
ROOF SQUARE.

an ordinary or bevel square may be used, which will be easily manipulated to indicate the correct angle, and locked in the required position, and which when not in use may be folded into small compass.

Heating and Lighting.

AUTOMATIC SAFETY WATER GAGE FOR BOILERS.—S. MUNSON, Fowler, Otero Co., Colo. This automatic gage is arranged to permit shutting off the steam or water from the boiler whenever it is desired to remove the main valve for replacing a worn-out gasket to prevent the gage from leaking when in use.

HEAT CONTROLLING SYSTEM.—E. P. CULVER, Schenectady, N. Y. The object of the inventor is to provide a heat controlling system in which a thermostat control is so interconnected with a diaphragm control that although the thermostat control shall operate



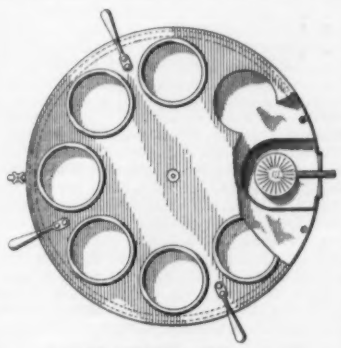
HEAT CONTROLLING SYSTEM.

to maintain the living-room temperature at the predetermined value, the diaphragm control will under any and all conditions prevent the thermostat control from causing to be generated within the heating boiler a pressure of steam exceeding a predetermined maximum.

Household Utilities.

FOOT AND HAND REST FOR TOILET SEATS.—W. B. SIMONSON, 713 Fulton St., Brooklyn, N. Y. The intention here is to provide a suitable support whereon the user may place hands and feet. The form is in the shape of a rack having cross bars in front for the feet, and pivoted frames at the sides for the hands. The pivoting of the frames to the rack enables the rest to be folded when it is not in use.

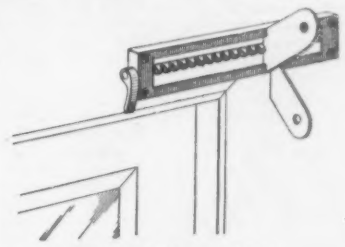
FOOD AND DISH WARMER.—J. W. STAGNER, 3116 Live Oak St., Dallas, Tex. In this invention the object is to provide a new and improved food and dish warmer, more especially designed for use in hotels, restaurants, boarding houses, homes and other places, and



FOOD AND DISH WARMER.

arranged to permit convenient storing of food and dishes with a view to keeping the same hot for any desired length of time, and to permit the diners to help themselves to the various foods. The patent is for sale.

WINDOW SHADE BRACKET.—L. G. RIPENBERICK, 476 First St., Albany, N. Y. This invention provides means for adjusting the bracket arms to suit shades of different widths, and thereby avoid the damage to window frames caused by repeated fastenings of

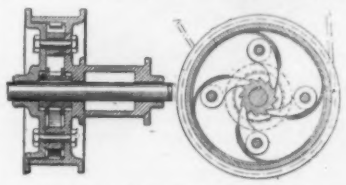


WINDOW SHADE BRACKET.

brackets at different points on the frame. Means provide for adjustably supporting the bracket arms that receive the shade roller; also the bracket to support adjustably the bracket arms, a plurality of which may be arranged to hold a plurality of window shades on a single window, as for instance, a dark and a light shade.

Machines and Mechanical Devices.

POWER TRANSMISSION MECHANISM.—L. MAIER, care of Mrs. J. G. Orth, Santa Rosa House, 4th and San Pedro St., Los Angeles, Cal. This invention relates to driving mechanism and has reference more particularly to



POWER TRANSMISSION MECHANISM.

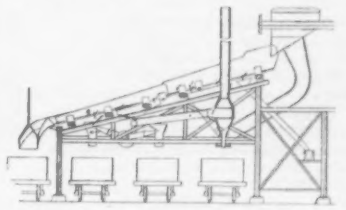
mechanism of this kind constituting a one-way clutch, and comprising a drum, a ratchet associated therewith and means whereby the drum and the ratchet are operatively connected when moved in one direction and are inoperative with respect to each other when moving in another direction. The patent in this case is for sale.

Prime Movers and Their Accessories.

ENGINE.—F. J. ZELLAR, 732 Columbus St., Grand Haven, Mich. The engine is of that type in which rotary motion of the engine shaft is produced by a piston composed of two slidably-connected sections which reciprocate rectilinearly as a unit by steam exerted alternately on opposite sides thereof, and in which the inner section reciprocates rectilinearly in a direction at right angles to the first named movement by steam admitted alternately at opposite sides of the inner section, the reciprocal movements taking place so as to produce rotary movement of the crank-pin of the engine shaft.

Railways and Their Accessories.

SEPARATOR.—REUBEN WILLIAMS, C. B. TITUS, and H. W. LINDENMUTH, Harrisburg, Ill. Address the first. The invention embodies the use of a suction apparatus for the purpose of cleaning and conveying small coal or coal dust from the larger sizes, and depositing the screenings or fine stuff in a car or



COAL SEPARATOR.

other receptacle. The suction apparatus is used in connection with vibrating screens which effect a preliminary separation or grading of the coal sizes, but such separation is incomplete or defective. To remedy this defect these inventors provide means for subjecting the screened coal of the various sizes to the action of an air suction apparatus which cleans the larger sizes and conveys the small stuff back to the screenings car.

CROSSING SIGNAL.—W. A. HESSE, 1015 Santa Clara Ave., Alameda, Cal. The principal object here is to provide a crossing signal adapted to be actuated when a tram approaches the crossing in order to give warning to those in the vicinity of the crossing, the construction contemplating a signal characterized by an oscillating arm.

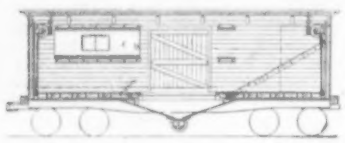
RAILROAD CROSSING.—A. J. HIGGINS, 1330 Bergen St., Brooklyn, N. Y. The invention provides at a crossing a continuous track for cars moving in either direction. This is attained by making the portion of each track between the crossing tracks of sliding rails, which are brought into position to one of the crossing tracks of a continuous unbroken rail and simultaneously withdrawing the parts of

the other track out of line with the continuous track.

RAILROAD TIE.—W. E. O'BRIEN and E. J. QUINN, Kenosha, Wis. The aim of this invention is to provide an inexpensive reinforced concrete cross-tie, simple, strong and durable, which will form a solid support for the rail and offer proper resistance to the variable stresses produced by the rolling stock and atmospheric conditions.

COMBINED LOCOMOTIVE TANK VALVE AND GOOSENECK.—W. J. MCGEE, 818 Third St., Macon, Ga. This inventor materially reduces the total weight of the tank valve, gooseneck and their appurtenances; does away with a large number of parts now used; provides a combined tank valve and gooseneck where no machinery will be required, or other finishing than facing the valve seat, and provides for permitting the hose being almost instantly disconnected from the gooseneck or the gooseneck from the valve, and an equally quick assemblage of the parts.

CONVERTIBLE BOX CAR.—H. W. CURRY, Box 114, Hudson Heights, N. J. This convertible box car has a hopper at its bottom which is normally closed by a valve member, the car having at each end of the hopper a movable floor member, there being means for raising



CONVERTIBLE BOX CAR.

the outer ends of the movable floor member so that grain disposed on movable floor member may be directed to the hopper to empty the car. These movable floor members have hinged portions, which may be raised to remove the grain which may fall between the floor members and sides of the car. With this car, grain may be quickly unloaded, and at comparatively little expense.

Pertaining to Vehicles.

AUTOMOBILE TIRE.—A. P. FOUQUÉ, 218 Flushing Ave., Brooklyn, N. Y. The invention relates to spring tires adapted to be employed on the wheels of automobiles and other vehicles as a substitute for pneumatic tires. The tire comprises an annular series of separate tread blocks, retractile springs secured at their inner ends to inner ends of the tread blocks, at the latter's side, these blocks having side grooves in which springs are disposed, and retaining means at the outer ends of the grooves, the spring's outer ends being secured to the retaining means.

DEMOUNTABLE RIM.—W. J. LANE, care of J. C. Wilkes, 336½ State St., Sharon, Pa. The invention refers particularly to a fixed and removable rim mutually engaged and means for keeping the same in a predetermined position and affording an easy and rapid separation of the same. The rim can be easily mounted on and removed from a vehicle wheel.

TWO-STAGE COMPRESSION PUMP.—G. J. SPOHRER, care of Wilson Motor Starter Co., Franklin, Pa. The invention relates in general to a piston pump and more particularly to the crank connections with the piston. This pump is particularly adapted for automobile use, in which the low-pressure cylinder is more nearly equal to the dimensions of the high-pressure cylinder, and the necessary ratio of cylinder volume is obtained by varying the extent of reciprocation of the pistons, by positioning the pins in the crank shafts different distances from the axis of rotation of the actuating shaft. This is one of the important features in economizing space in the invention.

SPRING AXLE.—S. NOTTINGHAM, Cuba, Allegany Co., N. Y. The invention relates to road vehicles, and has for its design to provide an improved arrangement of spring axle and appurtenances therefor, to the end that a vehicle wheel striking an obstruction may yield and rise to pass over the obstruction.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12832) S. R. asks: Given the earth a perfect circle of diameter 8,000 miles. A thin steel band is fitted just tight around the equator, and then cut apart. A strip 14 feet long is inserted and the band welded together; it is then placed concentric with the earth. What is the width of the space between the band and the surface of the earth? A. If the circumference of the earth were increased by 14 feet, the diameter would be increased by 4.46 feet. This is found by dividing 14 by 3.1416, the number π of the geometry. You will find the demonstration of this problem in answer to query No. 12266, vol. 103, No. 3, price ten cents. The diameter of the circle does not enter into the result. If the circumference of any circle were lengthened by 14 feet, its diameter would be lengthened by 4.46 feet. The width of the space between the band and the surface of the earth would be 2.23 feet—one half of the increase in the diameter.

(12833) I. S. G. asks: A base-ball is thrown into the air. It occupies 4 seconds in descending. Over what space has it fallen? $S = \frac{g}{2} \times T^2 = S = \frac{32}{2} \times 4^2 = 16 \times 16 = 256$ ft. Is the above solution correct? Why would it not be scientifically correct to say 32 feet or the momentum multiplied by 4 = 128 feet the ball fell, or 16 feet = the velocity times 4 = 64 feet the ball fell? You can see readily that my knowledge of mathematical physics is practically *nihil* so kindly explain this in detail. A. We are pleased to give you the answers to your questions in the order in which you put them. 1. The ball falls from a height of 256 feet. The formula which you use is correct. Its velocity at the end of one second, which we call g, is 32 feet. This is not the momentum of the ball. Momentum is the product of weight multiplied by velocity. To find the height from the velocity, you would proceed as follows: It fell 4 seconds, in which time it gained a velocity of 4 × 32, or 128 feet. Its average velocity is one half of this, or 64 feet, and moving with a velocity of 64 feet for 4 seconds it will fall 64 × 4, or 256 feet, as you have it. You will find all this in textbooks of elementary physics. Millikan and Gale's "First Course," which we send for $1.40, is a very interesting and instructive book. 2. What law of the universe is illustrated in the curve of a railroad track? A. The elevation of the outer rail of a railway track upon a curve is an illustration of centrifugal force. This prevents the overturn of the train, or its climbing the rails, if the speed on the curve is too high. 3. By what method is the distance between the earth and sun ascertained? A. The simplest mode of finding the distance of the earth from the sun is by means of the velocity of light, which moves at the rate of 186,300 miles a second. For the mode by which this was measured see SUPPLEMENT No. 557, price ten cents. It has been known for two hundred years that light comes to us from the sun in 499 seconds. Multiply 186,300 by 499 and you have nearly 93,000,000 of miles as the distance. There are other ways of obtaining the distance of the earth from the sun, but this is the simplest. For others see Young's "Manual of Astronomy," which we send for $2.50. 4. If a gun should be shot off, and one person would hear the explosion, another see the smoke, and another observe the falling of the bullet, who would be the first one aware of the shooting? Which second? Why? A. The person who saw the flash or smoke would be the first to be aware of the discharge of the gun. The second would be the one who saw the bullet fall. The sound would arrive last, provided all three persons were at the same distance from the gun. Light travels a mile in less time than one can perceive, so that the flash is seen at the instant it occurs over any distance to which it would be visible. The sound travels 1,090 feet in a second through air at the freezing point, and about 1,120 feet per second in the summer time. The ball will go 1,500 to 2,500 feet during the first second, according to the powder and rifle employed. Hence, the ball will arrive at a distant point before the sound of its discharge from the gun. 5. Explain in detail the cause of the ascension of a balloon. A. A balloon ascends if its weight is less than that of the air which it displaces, for exactly the same reason as a cork rises in water. 6. Remember hearing explained in a lecture on physics, that if one were standing in a boat, train, etc., and were to jump straight in the air, you would alight at the same place from which you had jumped. How could one prove this by a simple experiment? The height of the jump would have no effect, would it? A. A simple way to prove the fact that a rider must jump straight up in order to come down and alight on the same spot, as a circus rider does upon a horse's back, is to jump up in a moving car on a railroad train or a moving wagon on the road. You would not expect the car to run away from under you while you were in the air. You are moving along with the car, as the rider is on his horse. He continues to move in the same way while in the air, and so comes down upon the horse's back again. We call this action *inertia*. See this topic in a textbook of physics. 7. What is the size of the moon compared with the earth? A. The mean diameter of the moon is 2,163 miles, and that of the earth is 7,918.6 miles, as given by Young in the astronomy referred to above. 8. I heard it mentioned by a gentleman in a lecture that the cause of the revolution of the earth in space is as follows: At both poles are two holes, approximately three miles in diameter. There is a constant suction, and this suction draws the snow and ice into the bowels of the earth, which converts the moisture into steam, which is the force causing our planet to gyrate. This is not the accepted explanation, is it? A. We know no reason whatever to believe that there are holes in the earth at the poles, as both poles have been explored, and we know that the earth is solid and frozen there. We are certain that persons who ask questions as you have, would be interested in reading books which fully discuss these and we hope you will buy the books we have suggested, and study them.

(12834) J. M. S. asks: Has the equatorial line ever been positively placed, and how? Is there any stake or mark on land at any point to indicate the location of the equator? A argues that the equator is purely imaginary and has merely been placed in the minds of scientists, while B contends that though there is no actual substantial line drawn, nevertheless it has been actually and positively established beyond doubt by reliable instruments, and that it is no more imaginary than the boundary line between two of the United States. A. We do not know whether any government has placed any mark upon the equator in its territory or not, but there would be no difficulty in doing this. The equator is located by the position of the sun at noon. Its distance in degrees north of the equator in summer and south of it in winter is calculated exactly, and is relied upon by the captains of ships for finding their latitude day by day on their voyages. On land it is very easy to locate it exactly by a succession of observations. The equator is one of the most real lines in astronomy, surveying and navigation. The boundary line between two States could not be located unless the equator could be located with the same degree of exactness.

(12835) M. M. asks: Will electric waves from an electric wireless machine pass through earth or stone? A. Electric waves from an oscillator follow the surface of the earth rather than pass in a straight path through it. The lower half of the waves end in the earth, and if the earth's surface is a perfect conductor the waves would move over the earth freely; if a poor conductor, they are retarded. This accounts for the fact that transmission is better over water, and very poor over dry earth. See Pierce's "Principles of Wireless Telegraphy," which we send for $3. 2. Will electric waves from wireless machine be reflected if they strike against a sheet of oil of any kind? A. Electric waves are reflected, refracted and polarized in the same manner as light waves. Indeed, light is but an electro-magnetic phenomenon. You will find much upon this subject in Thompson's "Light, Visible and Invisible," which we send for $2.20. We cannot say whether all oils would be good reflectors of electric waves.

(12836) W. E. McC. asks: On Sunday evening, June 22nd, while sitting on the front steps of a residence in the northern part of this city in company with a friend, a meteor fell about thirty degrees from the zenith, or rather became visible at that distance from the point named and in a line almost due south from our point of vision. The meteor moved from northwest to southeast, apparently; rather a peculiar direction, was it not? It was of a reddish-yellow color and was followed by a train of reddish sparks. About the same moment I heard the sound of a distant explosion, which may have been caused by the meteor. My friend did not hear this, but she saw more of the display than I did, as I looked too late to see more than a thin trail of red sparks. I suppose that this meteor possessed no extraordinary features, but when it first appeared the sky was covered with clouds, and it passed through them before it became visible, a condition I never witnessed before. Thinking that it may possibly be of interest to the SCIENTIFIC AMERICAN, I write to call your attention to it. The clouds are very frequently at a high altitude in this prairie country, even rain clouds, such as these were, which may possibly account for the faintness of the explosion, which was not perceptible to the ear of my friend. A. Meteors come into the earth's atmosphere from every conceivable direction, and hence move in all possible directions across the sky. If one is to the south of a meteor, it will move through his northern sky; or if to the north, it will move through his southern sky. They are often so high above the earth that any sound from them is not heard upon the earth below, since sounds are not heard below as easily as above their place of origin. This is because of the lower density of the air at higher altitudes. It is very interesting to see a meteor appear from above the clouds.

NEW BOOKS, ETC.

PRINCIPLES OF SETTING-OUT. Securing and Tooling Operations. By Alfred Parr. With an Introduction by C. H. Bulleid, M.A., A.M.I.C.E. 8vo.; 290 pp.; 250 illustrations. Price, $2.50 net.

Out of the instruction in workshop practice given by Mr. Parr at University College, Nottingham, England, has grown this volume. Its examples are selected from the best engineering shops, and well illustrate all the stages and operations through which the work must pass. As "setting-out" now stands for so much more than drawing in scribing-block lines, the volume includes the use of special fixtures for holding the work on the machines, jigs for drilling through, and templets and gages for setting the tools and testing the accuracy of the work. The new Shaw electric measuring machine, which is capable of showing small inequalities even in the Johansson gages, is an instance of the development of precision in modern workshop practice. Engineering students and students in manual training and metal work will find in the book a fund of carefully-imparted information of great help to them in their studies.

MONEY CHANGING. An Introduction to Foreign Exchange. By Hartley Withers. New York: E. P. Dutton & Co., 1913. 8vo.; 183 pp. Price, $1.75 net.

Foreign exchange—the buying and selling of the money of other countries—is effected just as is the sale of any commodity of commerce, and, like other commodities, is affected by the law of supply and demand. It would probably be impossible to treat so ponderous a subject in any more simple, more human, and more appealing way than Mr. Withers has done, without seriously affecting the educational value of the treatise. He is always down among his readers instead of preaching from a lofty platform, and this fact, coupled with his innate modesty and his intimate knowledge of international money-changing, has resulted in a lucid explanation suitable for popular consumption. From the opening chapter on "Money at Home and Abroad," to the closing one dealing with the broad lesson to be learnt from study of the foregoing problems, our interest is never allowed to flag. There are even many smiles between the covers of the book.

HEATON'S ANNUAL. The Commercial Handbook of Canada and Boards of Trade Register. Ninth Year. 1913. 8vo.; 401 pp. Price, $1 net.

This Annual is one factor in a well-planned system of publicity aimed toward the upbuilding of the Dominion and of the Empire. It is distinctly framed with the intention of saving time and money for investors, merchants, and intending settlers by giving them valuable information issued by a specially-trained and thoroughly competent staff. The first part of the book presents the Canadian customs tariff, law, and regulations. In the second part is an alphabetically arranged description of all the important towns, and of those agricultural districts which are attracting immigration. Officials and boards of trade throughout the Dominion have heartily cooperated in making the work authoritative and full.

ECONOMY AND SYSTEM IN THE BAKERY. By Emil Braun. Cincinnati: Stewart & Kidd Company, 1913. 8vo.; illustrated.

Mr. Braun is well qualified by his long experience to give bakers a handbook that shall be of great benefit to them, whether their businesses be large or small. As the author points out, economy and system in the small bakery is necessary before the foundations of a larger business can be laid. Chemical knowledge, flour tests, dough making, heat and the ovens, modern machinery and equipment, and system and economy, are the headings under which instruction is given.

HOW TO INSTALL ELECTRIC BELLS, ANNUNCIATORS AND ALARMS. By Norman H. Schneider. New York: Spon & Chamberlain, 1913. 12mo.; 83 pp.; illustrated. Price, 50 cents.

This is a short manual of explanation and instruction on batteries, wires and wiring, circuits, pushes, bells, burglar alarms, high and low water alarms, fire alarms, thermostats, and the location and remedying of troubles.

ARTISTIC LEATHER WORK. A Handbook on the Art of Decorating Leather. By E. Ellin Carter. New York: Spon & Chamberlain, 1912. 16mo.; 51 pp.; illustrated. Price, $1.

Leather work is an art of ancient lineage, and one which lends itself well to the highest and most satisfying expression of taste. The plates from work executed by the author prove her to be herself an artist of no mean ability, and a perusal of the little volume demonstrates her success in imparting deftness in the use of tools as exemplified in incised, embossed, modelled, carved and hammered work, in coloring and staining, in padding and in making up.

INQUIRIES

Inquiry No. 9313. Wanted to buy Leather Held Horse Shoes used temporarily when shoe cannot be nailed on. In other words a Leather Boot with iron shoe at bottom—strapped over horse's foot.

Inquiry No. 9314. This enquirer is in the market for some patented articles which he could purchase and manufacture with an investment of from $5,000 to $10,000. The name of the party will be supplied to any of our readers on application.

Inquiry No. 9315. Wanted the name and address of a concern manufacturing novelty ink wells.

Inquiry No. 9316. Wanted the names of manufacturers and manufacturers' agents who make patented articles and other useful devices which appeal to the public and which can be used in a mail order business and by canvassers.

Inquiry No. 9317. Wanted the names and addresses of manufacturers of good selling articles that would appeal to the public where exclusive sale in certain territories can be arranged for; both to sell to the trade and through sub-agents in a house-to-house canvas.

Inquiry No. 9318. Wanted rollers and other appliances for extracting water and moisture from refuse, such as coir dust, with special reference for using it as a fuel.

The Heavens in August

(*Concluded from page 90.*)

in fact, the two planets are in conjunction on the 24th, and little more than 1 degree apart. Saturn is the farthest south, and is a little the brighter of the two, while Mars is moving eastward more rapidly, and so overtakes the larger planet. This conjunction will be a very pretty sight, but one must get up in the morning to see it.

Finally, Neptune is in Gemini, lately past conjunction with the Sun, and observable only in the morning. On the 29th he is in conjunction with Venus, being but 18 minutes north of her.

The Moon is new at 8 A. M. on the 2nd, in her first quarter at 11 P. M. on the 8th, full at 3 P. M. on the 16th, in her last quarter at 7 P. M. on the 24th, and new once more at 4 P. M. on the 31st. She is nearest the Earth on the 3rd, and again on the 31st, and farthest away on the 18th. As the new Moon at the end of the month almost coincides with the time of perigee, unusually high spring tides may be expected.

While completing her circuit of the skies, the Moon comes into conjunction with Neptune on the 1st, Mercury on the 2nd, Jupiter on the 12th, Uranus on the 15th, Saturn and Mars on the 26th, Venus and Neptune on the 28th, and Mercury again on the 30th.

Chamonix, France.

Curious Exotic Fishes

(*Continued from page 92.*)

then with minced boiled rice or vermicelli, and earthworms twice weekly.

The *Sacobranchus singio*, a little catfish found in Bengal, is distinguished by its bristling mustaches from its companions in the aquarium. The gray, striped *Sternopygus* is a South American eel of the *Gymnotus* family, but destitute of electric properties and having a single ventral fin. Somewhat similar to both of these in form and movement is the African *Xenomystus*, six or eight inches in length, which is a native of the river Niger and requires a temperature of about 80 deg. Fahr.

The armored catfish (*Plecostomus Commersoni*) is a remarkable member of some European collections. The sides of this fish are covered with dark colored scales, arranged like roof-tiles, and a long plate protects its head. The dorsal fin is very large.

The Brazilian moon fish (*Pterophyllum scalare*) is as variegated in color as it is curious in form.

The *Pantodon*, a diminutive flying fish found in Lake Tchad, in Africa, merits especial attention because of its peculiar structure and singular habits. It owes its name to the formidable array of teeth which cover its tongue and the principal bones of its mouth, in addition to the jaw-bones proper. The dorsal fin is very short and is placed near the long and pointed tail. The folding pectoral and ventral fins are very large, and the latter terminate in fine filaments. These organs suggest great powers of flight, and, as a matter of fact, M. Fonreau, of the Lake Tchad mission, has seen the pantodon rise from the water and, by flapping its pectoral fins, traverse distances of 5 to 20 yards, or more. These are long flights for a fish only two or three inches in length. In the aquarium the *Pantodon* remains quietly at the surface in the attitude shown in the photograph, which, unfortunately, cannot reproduce the gorgeous livery of this butterfly of the water. The back is olive, in some specimens crossed by transverse dark bands; the belly is silvery yellow, tinged with carmine; the fins are bright pink dotted with violet brown, and the tips and inner surfaces of the pectorals are violet-hued.

It is impossible to mention here all of the exotic fishes of comparatively recent importation in the possession of M. Lefèvre, M. de Visser, and other members of the Aquaria Society, formed for the purpose of promoting the cult of ornamental fishes, but the remarkable habits of the macropods and the guramis de-

serve description. The male fish builds a tiny nest of foam, into which he entices the female by assuming a nuptial livery of the most brilliant coloring, but, as soon as she has deposited her eggs, he drives her away and takes upon himself the duties of the mother and nurse, to which he devotes himself zealously until his offspring become able to find their food unaided. This maternal instinct of the male is strongly developed also in the chanchito (*Heros facetus*). One of these curious fishes in the aquarium of one of my friends had a brood of sixty little ones, which he defended valiantly, promptly attacking and biting any finger that was rashly plunged into the water. The worms and raw beef on which the young fishes were fed were chewed fine by the father, and an amusing spectacle was presented by the little ones taking their food from their father's lips.

Some exotic fishes are even more brilliant in coloring than those described above. The orange-colored coat of the *Scatophagus argus*, for example, is adorned with artistically arranged dots of velvety black, and a beautiful azure bead marks every scale of the Brazilian *Cichlide*.

It might be supposed that these living gems of tropical waters require constant care. On the contrary, they can be kept without trouble in an ordinary dwelling or apartment. Although M. Lefèvre, who propagates these exotic fishes on a large scale, has installed his aquariums in two hothouses, and Mme. Kuhnt conducts an elaborate piscicultural establishment near Berlin, M. de Visser keeps his fishes in tanks of about 25 gallons capacity on a glass-inclosed veranda, where species of very different dimensions and origin dwell together in harmony.

The proper water temperature (about 70 deg. Fahr. for most species, and 80 deg. Fahr. for a few others) is maintained, usually, by means of an alcohol lamp contained in a nickel-plated cylinder, which is ballasted so that it floats in a vertical position with its open top, which is covered by a fine wire grating, alone emerging from the water. The aquarium may also be heated by lamps placed in a lower compartment, separated from the tank by a double partition. Large and pugnacious fishes, and some others at the breeding season, are confined singly in glass globes. In marked contrast to domestic fresh water fishes, which do not thrive in captivity unless they are kept in running or frequently renewed water, these exotic fishes may safely be kept for months in an aquarium without a complete change of water. It is sufficient to draw off one tenth part of the water every week, and to replace it with an equal quantity of fresh water of the proper temperature. Adequate aeration, however, is essential. This may be effected very easily by placing in the bottom of the aquarium the end of a rubber tube, communicating with a compressed air cylinder, in which a pressure of three atmospheres, as indicated by an attached manometer, is maintained by means of an automobile tire pump. The immersed end of the tube is closed by a thin membrane, which is traversed by a steady stream of minute air bubbles.

The sandy bed of the aquarium is planted with *Vallisneria*, *Miriophyllum* and other green aquatic plants which are useful as well as ornamental, as they assist in oxygenating the water, afford shelter to the fishes and facilitate their reproduction.

The cultivation of exotic aquarium fishes deserves every encouragement, for it is not only a source of enjoyment, but it offers a field for scientific observation of the curious and still imperfectly studied habits of these pretty little creatures.

Dead Matter That Seems Alive

(*Continued from page 93.*)

pearl, in tendons, in voluntary muscle fibers and in other organic structures. A section of striated structure produced by diffusion currents is shown highly magnified in Fig. 3.

The general appearance of a cell, with its nucleus and plasmic streaming, with

nuclear division figures, with various kinds of outgrowths, had been described by Leduc in earlier writings, together with the osmotic growths of various kinds, suggesting molds, sea-weeds, toadstools, etc. Both series of phenomena were referred to and illustrated in the SCIENTIFIC AMERICAN, September 9th and 23rd, 1911. Fig. 4 is a reproduction of one of Leduc's "artificial" nerve cells, shown alongside of a ganglionic cell (Fig. 5) prepared by Demoor according to Golgi's method. Leduc's "cell" was produced by placing a "seed" consisting of two parts of copper sulphate and one part of cane sugar in a solution of ferrocyanide of potassium. A precipitate of copper ferrocyanide is formed on the surface; this is impervious to sugar, but water is readily absorbed through it, leading to "growth" in all directions, the final form depending upon the precise distribution of the particles of sugar and of copper sulphate in the grain, upon variations in the density of the medium, etc.

Much of the argument in the book is devoted to showing that the lines of dynamic discharge are essentially the same in an organism and in organic media. To this end illustrations are derived from a comparison of electric discharges and crystallization figures with ferns and other plant structures. Fig. 8 is the electric discharge resembling a leaf; Fig. 10, an electrolytic pattern suggesting a fern frond; Fig. 11, a crystallization of ammonium chloride in gelatin suggesting plant forms; Fig. 9, four successive stages in "karyokinetic" figures produced by diffusion; Fig. 12, a modification of diffusion currents by contact of a glass rod, illustrating irritability; and Fig. 13 shows "negative heliotropism" of diffusion currents of India ink in salt solution.

With wonderful patience and ingenuity Prof. Leduc has taken up in turn the commonly recognized characteristics of living cells—their structure, their absorption of nutrients, their nuclear division, their irritability, the circulation, the relation of temperature to function, their transformation of energy—and has reproduced each phenomenon in turn in a preparation which is admittedly "non-living." But has he thereby made an approach to the artificial synthesis of life? All that we can learn from these experiments is that the laws of motion and of matter are as evident in the world of living things as in the world of non-living; that motion here is along the line of least resistance as it is there; that the mechanics and the electrics and the chemics of living cells are the same as those of non-living systems.

The chapter on the origin of life and spontaneous generation is a sane statement of the problem, and in it Dr. Leduc points out the logical necessity of assuming that life not only did originate "spontaneously"—in a scientific sense—but may do so again under suitable conditions. He also points out the evasion of the issue involved in such theories as that of Arrhenius in regard to the extra-terrestrial origin of life.

Whether the methods of Leduc ever reach the bottom of the problem or not, these experiments have their value in clearing the field of much conjectural rubbish and confusion; and as for the synthesis—that has not yet reached the experimental stage.

The Airman and the Weather

(*Continued from page 94.*)

is now able to draw a vertical plan of the thundersquall (Fig. 2), tracing its quasi-circulation about a horizontal axis, as a guide to the maneuvers the airman should adopt if overtaken by a storm of this character. This is strikingly analogous to the task of the nineteenth century meteorologist in tracing the ground plan of the cyclone, and teaching the mariner how to avoid the "dangerous semicircle."

However, the aeronaut needs horizontal as well as vertical plans of the wind systems he is likely to encounter—cyclones and anticyclones, land and sea breezes, trade winds and antitrades, and all the

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other members of the atmospheric circulation. He needs to know, for example, the relation of the winds to the isobars at various levels in a typical cyclonic disturbance. It is a distinct advantage to him to learn that, while at the earth's surface the winds blow spirally inward toward the center of a depression, at the mile-level overhead they are no longer inclined inward, but blow in such a direction that the isobars on the surface weather map correspond approximately with the motion of a free balloon at such a level. Thus aeronautical meteorology, which is a science of three dimensions, is vastly more complicated than marine meteorology, which is a science of only two.

Let us repeat, however, that in spite of the magnitude of the tasks imposed upon it, aeronautical meteorology has already reached a stage of great practical utility. A single illustration will make this clear. Suppose plans were on foot to establish a regular airship service across the Atlantic, where would be the most favorable route? Meteorology is ready to answer this question. For the westward journey there is one region, and one only, in which the winds are favorable throughout the year, viz., the trade-wind belt. For the eastward journey a sea-level wind chart might suggest the advantage of a more northerly route, in the zone of "prevailing westerlies." Aerology, however, can better this suggestion. The winds of middle latitudes, although westerly in terms of averages and resultants, are actually subject to the vicissitudes attending the frequent passage of cyclonic disturbances. There is only one region in which there is a tolerably steady drift from west to east, and this is the zone of the anti-trades,[2] lying vertically over the trade winds. Hence the first transatlantic airships will probably sail from southern Europe to the West Indies at a low level, and return in the same latitudes at a level a few thousand feet higher. The tropical hurricanes that occasionally invade this region during the late summer and early autumn will be announced by wireless telegraphy from the meteorological bureaus, and the aerial liners will give them a wide berth—or possibly rise to the upper level of the storm itself and take advantage of the outflowing winds at that level to get away from the storm center.

Aerologists have now been at work for several years sounding the air above the trade-wind belt. The trades are found to be quite shallow, and their depth varies considerably with latitude.

We have not space here for even the most summary digest of the science of aeronautical meteorology, but must limit ourselves to an enumeration of its principal subdivisions. We have already devoted considerable space to the wind, as the subject of capital importance. Under this head let us add that valuable statistics have been compiled as to the variation of the force and the direction of the wind with altitude (see, for example, Fig. 3); that the average windiness of various places on the earth's surface has been determined, in order to point out the most favorable locations for aerial harbors and aerodromes; that the relation of the winds at moderate altitudes to the topography of the land has been worked out in great detail; and that ingenious forms of apparatus (e. g., the vertical anemometer and the pilot-balloon) have been devised, to supplement the ordinary anemometer and wind-vane for aeronautical purposes. The elaborate investigations on wind pressure and the like carried out in aerodynamic laboratories, belong to engineering rather than to meteorology.

Temperature is a very important factor in ballooning; less important in aviation. Here, again, aerology has gathered a great fund of information. We know not only the normal temperature gradients in the atmosphere, but also under what conditions these gradients are likely to be interrupted or reversed. The typical vertical and horizontal distribution of temperature in cyclones and anticyclones—a subject concerning which very erroneous opinions formerly prevailed—has now been approximately determined.

So with the other meteorological elements. Each of them, thanks to the advent of aerology, has now been studied for several years from the three-dimensional point of view, which is the point of view of aeronautics.

Of the special storm warning services for aeronauts recently established or projected we have not space to speak. They are the logical corollary of the science of aeronautical meteorology, and will soon be commonplace institutions the world over.

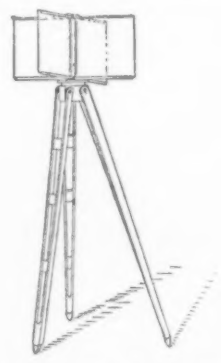
[2] The term "antitrade" is sometimes used in a broad sense to include not only the high-level wind above the trades, but also the supposed extension of this wind at sea-level in higher latitudes, i. e., the "westerlies" of the temperate zone. It is here applied to the upper current of the tropical belt only.

Device for Detecting Flight of Mosquitoes

By L. E. Haskell

AN instrument for detecting the direction of flight of adult mosquitoes has been invented by E. F. Quimby and has been put in operation with a great deal of success on the Isthmian Canal Zone. Mr. Quimby, division inspector in the Department of Sanitation on the Canal Zone, perfected his device for the purpose of ridding the more remote parts of the zone from mosquitoes.

The device consists of a metal frame holding four plates of glass each 12 by 12 inches in size, placed upon a tripod. The glass plates are held stationary at right angles to one another, so that when the instrument is set up, they point north, east, south and west. To catch the mosquitoes, a coat of tanglefoot, composed of one half pound of rosin to one liter of castor oil, is prepared, and when applied to the glass is practically transparent.



Device for detecting the flight of mosquitoes.

Many interesting and important facts regarding the habits of the mosquito have been learned. It was found that the adult mosquito flew on the quarter of an eighteen mile an hour wind; that the evening flight occurred between 6:10 and 7:10 o'clock; that there was a complete lull in the flight after 7:10 o'clock; and that there was a return flight between 5:50 and 6:40 o'clock in the morning, also on the wind's quarter.

The instrument has proved to be useful in locating breeding places by eliminating the area facing the plates that do not show a catch. It has established a means of finally exterminating mosquitoes on the Canal Zone. The device points out the direction of the breeding places; a thorough search; the discovery of swampy ground or pools of stagnant water; a little kerosene; and the breeding place is clean.

A Combined Life-boat and Marine Safe.—The patent No. 1,064,472, to August Haas of Grapeville, Penn., shows a ship with a berth open at one end through a wall of the ship and having downwardly and outwardly inclined slideways with an emergency boat having its greatest depth at its stern and decreasing in depth toward its bow and supplied with runners so that it can be supported on the slideways, with securing means for removably holding the boat in the berth.

Navy to Determine Longitude by Wireless; also Speed of Hertzian Waves

By Louis E. Browne

ONE of the most important duties of the United States Naval Observatory is the exchange of time signals with naval hydrographic surveying parties, for establishing the longitude of points on the coasts of Cuba and Central America, which these parties use as bases of their surveys. Formerly these signals were exchanged by telegraph or cable, but of late radio-telegraphy has been resorted to for isolated stations without cable connections. This method seems to offer such advantages that the Navy Department is contemplating the abandonment of the telegraph and cable signals.

The Naval Observatory was the first institution in the world to have its time signals regularly transmitted by wireless, thus enabling ships at sea to correct their chronometers and thereby more accurately to determine their longitude, but the French have become pioneers in the method of exchanging radio signals between shore stations, for the determination of differences of longitude.

In view of the approaching completion of the powerful wireless station at the Eiffel Tower in Paris, the French government inaugurated an international conference to consider questions of regulating radio time signals. The United States was represented by Commander H. H. Hough, the Naval Attaché at Paris, and Prof. A. Hall of the Naval Observatory.

Recognizing the importance of determining the difference of longitude between Washington and some point on the European continent, in order that it may be used as a base for hydrographic and military survey on this continent and the islands of the Caribbean Sea and the Pacific Ocean, the Navy Department proposed that time signals be exchanged by the powerful Arlington wireless station in Washington and the Eiffel Tower station in Paris.

Preliminary investigations are now going on, and while an approximate determination of longitude is expected to result from them, the principal benefit to be derived is the familiarizing of officials of both nations with the methods to be used, to enable them to decide upon a plan of operation for the final tests which will be made this winter. Two instruments, especially designed for the astronomical work, will be of the highest excellence. The very fine meridian circles which are installed in the Naval Observatory will be cast aside; for it is desirable that the instruments used in Washington and Paris should be as nearly identical as science can make them and of such size that they may be interchanged, so that an observer here, after a series of observations lasting several weeks, may take his instrument to Paris and repeat the operation there, the observer in Paris transferring his instrument to Washington. In this way all instrumental and personal errors will be practically eliminated.

As soon as this determination is completed the Washington Government contemplates a determination of the difference of longitude between Washington and some point on the Panama Canal Zone and other important points on the Central American coast. The survey of the Panama Canal Zone, relatiyely to Europe as well as the United States, grows more and more important as the date for the opening of the canal approaches.

Connected with this work, and fully as important to the scientific mind, is the problem of determining the velocity of propagation of the Hertzian waves. Although this phase of wireless telegraphy has greatly interested scientists the world over, and many theories have been advanced, so far no true determination has even been attempted. It has been considered that the Hertzian waves travel at about the speed of red calcium light, that is, about 186,000 miles per second. It is held that this is only an approximate estimate and that the Hertzian waves may

The Ten Greatest Inventions of Our Time

We hear much of the great inventions of the past—the telegraph, the sewing machine, the telephone, the reaping machine, photography, Bessemer and open hearth steel, the steam engine and the phonograph. Yet the inventions of our own time are as epoch-making and as dramatic as these.

Perhaps because we have become accustomed to the use of the old machines and discoveries, perhaps because the achievements of latter-day inventors succeed one another so rapidly that we are not given much time to marvel at any one of them, we have not fully realized how stirring and wonderful are the products of modern ingenuity.

Only five years ago the man-carrying aeroplane made its first public flights; only the other day hundreds of passengers on a sinking ship were saved with the aid of wireless telegraphy. At least a dozen inventions as great have been perfected in our own time, and all of them have made a man's work count for more than it ever did before, and have made the world more livable than it ever was.

Why should we not tell the story of our own deeds?

Why should we not review the industries created by men who are still living, men whose names will go down into history with those of Watt, Morse, McCormick and Howe?

That was the underlying idea of the November Magazine Number of the Scientific American. We knew that the "ten greatest inventions of our time" was a big subject when first we planned the number, but how big it was we never realized until we surveyed the field of modern invention.

Then we saw how astonishing was the progress made in our own day, how much mankind had benefited by the inventions of great modern intellects. We began to appraise inventions, to weigh one against the other, and to determine in our own minds which ten had contributed most to human progress and happiness, which were really great pioneer inventions, and which merely remarkable and valuable improvements on successful past conceptions. There were so many achievements to consider that it was hard to arrive at a definite conclusion.

The upshot of our own thinking has been to leave to our readers the decision

What Are the Ten Greatest Inventions of Our Time, and Why?

For the Three best articles on the subject, the Scientific American offers in the order of merit, three cash prizes:

First Prize: $150.00 for the best article
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Third Prize: $50.00 for the third best article

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travel either 100,000 miles a second faster or a few thousand miles slower.

The difference of longitude of two places will be determined by the difference in time, and this is determined by the observations of so-called clock stars over the meridians of the two places, the greatest care being taken to eliminate all mechanical and personal errors. Everything being ready, star observations will be made to determine the errors in the clock or chronometers to be used at each place. The errors of the two timekeepers being known as the result of these observations, they are then compared by means of wireless signals to determine the difference in time between the two places. There are several ways of doing this.

Both clocks will be regulated to beat slightly different times; for instance, one will beat mean time seconds and the other sidereal seconds. This makes the beats of the clocks coincide about every six minutes. If then the clock-beats, in Paris, close the circuit of the wireless apparatus, they will be transmitted through the ether and read in Washington at the Arlington wireless station. The observer in Washington will be equipped with a double head telephone, receiving the radio signals in one ear and the beats of the Washington clock in the other. In this way he can tell when the coincidences occur, and by means of conventions arranged beforehand between the two stations the exact time of the coincidences will be known at each station.

In this way it is expected to determine the difference in time and consequently the difference in longitude to within 1/100 of a second. The sidereal second being less than the mean time second by 3/1000, the method of coincidence provides a means of detecting that small fraction of time if one can absolutely tell when the coincidences occur.

The process is then repeated, Arlington sending and the observer at the Eiffel Tower receiving the beats of the Washington clock as automatically repeated by radio-telegraphy and beats of the Paris clock in the other ear.

Paris is roughly 3,000 miles from Washington. Using the estimate that the Hertzian waves travel with a velocity equal to that of light, it would take 1/60 of a second for the wireless flash to make its trip across the ocean and would take 1/30 of a second for a round trip. A recording apparatus will be set up in Paris which will be capable of revolving at a speed of from 1,000 to 5,000 revolutions per second. A wireless flash sent by the Paris station will be heard in Washington, and, if possible, will be automatically flashed back again, thus automatically registering on the revolving drum in the Paris observatory. This test will not take place until after the longitude tests have been completed.

There is considerable doubt as to whether the method will be practicable, for at present there has been no invention which would permit the "flash back" to the sending station without some degree of personal error.

The Current Supplement

AN article in this week's SUPPLEMENT on the design and use of scientific instruments in aeronautics will be found to state fundamental principles of design applicable also in other fields.—A masterly model of Rome at the time of Constantine is illustrated and described.—F. W. Parker writes on "The Spirit of Invention."—John A. Britton contributes an article on Hydro-electric Development in California.—An article by Dr. Gleichen deals with certain defects inherent in photographs as ordinarily prepared.—A most important contribution to the study of heredity is a paper by Prof. E. B. Wilson, in which it is shown how the investigation of the microscopic structure of the cell sheds light on Mendelian inheritance.—Prof. Hirshfeld's article on Fuel Oil Engines is concluded in this issue.—A *résumé* is given of our knowledge of the bacterial flora of eggs.

THE ROTARY STEAM ENGINE

¶ The Rotary Steam Engine has attracted the best thoughts of inventors and students for many years. All interested should read carefully the very complete information found in the files of the Scientific American Supplement. Every class and type of rotary engines and pumps is described and illustrated.

Scientific American Supplement 470 describes the Harrington Rotary Engine, a form of intermittent gear.

Scientific American Supplement 497 describes Fielding & Platt's Universal-joint Rotary Engine.

Scientific American Supplement 507 describes the Jacomy Engine, a square-piston type.

Scientific American Supplement 528 describes Inclined-shaft Rotary Engine, using the universal-joint principle.

Scientific American Supplement 558 describes the Kingdon Engine, a "wabble-disk" design.

Scientific American Supplement 636 describes Riggs' Revolving-cylinder Engine, suggesting the present Gnome motor.

Scientific American Supplement 775 describes Revolving-cylinder engines of several forms.

Scientific American Supplement 1109-1110-1111 contains a series of great interest, describing and illustrating all the principal types of rotary engines and pumps. This set should be studied by every inventor and designer.

Scientific American Supplement 1112 describes the Filtz Rotary Motor, using helical surfaces.

Scientific American Supplement 1158 describes Hult's Rotary Engine, an eccentric-ring type.

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Scientific American, No. 23, Vol. 102 contains a full description of the recent Herrick Rotary Engine, an eccentric type with swinging abutment.

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